6.81

33

THE

EDINBURGH NEW

PHILOSOPHICAL JOURNAL.

THE

EDINBURGH NEW PHILOSOPHICAL JOURNAL,

EXHIBITING A VIEW OF THE

PROGRESSIVE DISCOVERIES AND IMPROVEMENTS

IN THE

SCIENCES AND THE ARTS.

EDITORS.

THOMAS ANDERSON, M.D., F.R.S.E.,
REGIUS PROFESSOR OF CHEMISTRY, UNIVERSITY OF GLASGOW;
SIR WILLIAM JARDINE, BART., F.R.S.E.;
JOHN HUTTON BALFOUR, A.M., M.D.,
F.R.S., SEC. R.S. EDIN., F.L.S.,
REGIUS KEEPER OF THE ROYAL BOTANIC GARDEN, AND PROFESSOR OF MEDICINE AND BOTANY,
UNIVERSITY OF EDINBURGH.

FOR AMERICA,
HENRY D. ROGERS, LL.D., Hon. F.R.S.E., F.G.S.,
STATE GEOLOGIST, PENNSYLVANIA; PROFESSOR OF NATURAL HISTORY IN THE
UNIVERSITY OF GLASGOW.

JANUARY ...... APRIL 1862.

VOL. XV. NEW SERIES.

EDINBURGH:
ADAM AND CHARLES BLACK.
LONGMAN, BROWN, GREEN, & LONGMANS, LONDON.
MDCCCLXII.

620920
19.10.55

Q
1
E37
n.s.
v. 15

EDINBURGH:
PRINTED BY NEILL AND COMPANY, OLD FISHMARKET.

THE

EDINBURGH NEW

PHILOSOPHICAL JOURNAL.

On the Chemical Geology of the Malvern Hills. By the Rev. J. H. Timins, M.A. of Trinity College, Cambridge, Vicar of West Malling, Kent.

The constitution of the rocks of the Malvern Hills is a subject of much interest to the geologist, but its complete investigation is a work of some difficulty. As stated by Professor Phillips, there are in the chain "granite, syenite, greenstone, hornblende rock, felspar rock, serpentinous rock, epidotic rock, and other nameless products of igneous action. A rock which cannot be technically distinguished from gneiss is abundant, and some varieties might receive the name of chloritic, and even micaceous schist. But the manner in which all these are associated, and some of them graduate into others, is so perplexing, and the phenomena are so continually and variously repeated, even in very limited tracts of the mountain, as to demand the utmost care in reasoning on their probable origin."

A sytematic analysis of the several rocks in different parts of the chain may help to remove the obscurity in which this question is involved; and it may furnish important information as to the chemico-physical processes which have resulted in the development of the older crystalline rocks, the sources from which they have been derived, and the nature of the metamorphic influences to which they have been exposed.

Although the study of the Malvern rocks is frequently made very difficult by varied and unequal crystallizations and extensive segregations, there are, notwithstanding, in all parts of the hills, rocks in which the components are distributed with tolerable uniformity throughout the mass. I propose to consider these in the first instance; and when their constitution shall have been fully determined, we shall have less difficulty in forming an opinion as to the origin of rocks of a less simple character.

We find, on examination, that in many of these rocks, the ratio of the oxygen of the silica to that of the bases is as 3 : 2, which corresponds to that of aluminous augite and of labradorite, and of course also to any combination of the two. This is the ratio assigned by Bunsen to one principal division of the characteristic eruptive rocks of Iceland. We meet with rocks of this ratio in all parts of the Malvern Hills, and under various forms. Thus, in a fine-grained mixture of hornblende and epidote in the North Hill (xii.); in a red rock, with epidote and gold mica, further south (xiii.); in a grayish black rock forming a vein in the syenite over West Malvern (x.); in a similar rock from the railway tunnel, under the South Hill (xi.); in some of the peculiar traps of the West Ragged stone, and of the dykes at its base (xiv. xx.), the ratio of the oxygen of the silica to that of all the bases taken together is nearly as 3 : 2. In other rocks, this ratio is as 3 : 2½, as we find it to be in some bosses of trap on the hill above Bransill Castle (xv. xvi.), and in the rocks of the large quarry between North Malvern and West Malvern (i.–iv.) And other rocks have an intermediate composition, so that we pass, by scarcely perceptible gradations, from one of these classes to the other; and this variation is found to prevail as much amongst those rocks which closely resemble each other in appearance as amongst those which are dissimilar. It should be observed that many of these rocks bear evidence of some alteration from their original composition: the quantity of water contained in them being large, and portions of their silica as well as of their bases being found deposited in their fissures and cavities.

The accompanying table will show the result of the analysis of some of these rocks taken from various parts of the chain. The *first* line gives the quantity of silica found in *all* the ingredients of the rocks, including *water;* the *last* line gives the percentage of silica *after ignition.* This is slightly underrated (in no case by more than 1 per cent.), owing to the increase in the weight of the ignited rock by the higher oxidation of the iron.

Analyses of Rocks taken from various parts of the Malvern Chain.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.	XV.	XVI.	XVII.	XVIII.	XIX.	XX.	XXI.
Silica, ...	43·71	43·81	44·67	42·87	44·77	45·33	45·01	46·23	43·33	47·63	48·71	49·77	49·08	48·97	40·00	39·25	43·53	42·30	44·25	48·25	58·64
Alumina, ...	18·33	20·50	20·40	17·50	17·30	19·10	18·61	17·65	15·40	16·64	20·75	19·73	21·65	18·75	18·15	15·26	13·48	20·24	21·75	21·42	15·35
Protoxide of Iron, .	18·81	17·68	16·11	...	18·88	15·71	16·72	14·76	16·93	14·98	15·90	13·10‡	...	7·53‡	12·44	12·97	12·23	10·93	9·05‡	8·47	8·59
Peroxide of Iron, .	1·25	2·00	0·75	21·23†		1·75	trace	trace	0·75	...	...	...	11·05	...	...	...	...	...	...		...
Oxide of Manganese,	0·55*	0·75	0·60*	0·25	0·30	0·75	0·50	0·75	2·00	0·90	1·25	0·70	0·60	1·10	1·50	1·50	1·75	0·75	1·10	1·00	1·75
Lime, ...	5·25	5·10	6·36	4·99	5·80	5·75	6·25	5·34	6·30	8·46	5·70	9·46	7·85	5·18	6·70	6·97	10·22	3·20	4·60	3·85	2·31
Magnesia, ...	3·15	3·44	2·15	2·62	4·15	2·10	4·12	5·15	4·19	4·37	3·82	2·66	2·87	4·57	7·40	9·87	7·30	10·41	3·74	5·45	3·29
Loss at 212°, . . .	3·12	2·22	2·07	1·50	1·06	1·29	0·50	1·57	1·80	0·58	0·80	1·12	1·40	1·82	2·07	3·52	1·70	3·51	4·78	1·98	3·22
Loss on ignition, .	1·65	1·30	...	3·05	2·26	4·71	3·10	3·10	4·15	3·00	1·00	1·76	2·70	4·78	7·27	5·51	5·53	5·58	3·61	4·38	3·77
Potass, ...	1·10	3·20	1·20	5·99	5·18	3·51	0·50	5·45	5·15	3·44	0·18	1·40	0·33	7·30	4·47	5·15	4·26	3·08	7·12	2·60	0·15
Soda and Loss, . .	3·08		5·69				4·66				1·89		2·47							2·60	2·93
Percentage of Silica after ignition, .	45·90	45·40	45·61	44·91	46·31	48·22	46·72	48·49	46·07	49·40	49·60	51·39	51·18	52·44	44·12	43·14	46·92	46·53	48·30	51·52	62·05

* With some Oxide of Copper. † With some Protoxide. ‡ With some Peroxide.

I. Rock from a large quarry between North Malvern and West Malvern, disposed in horizontal tabular masses. Formerly broad slabs were obtained from hence, which were extensively used in the railway works; but these have been removed, and the rock which remains is loose, separating readily in nearly vertical lines. It is superficially stained with hydrated peroxide of iron. The iron in the interior of the rock is generally in a low state of oxidation, but some of it is in the form of anhydrous peroxide. There is much sulphate of baryta in this and in other quarries to the north of it. The rock, although easily fusible, is not altered where in contact with it: crystals of calc spar are found intermingled with it; and where the fissures are large, they are not filled by the sulphate of baryta, which is deposited in crystals on the opposite surfaces, leaving a vacant space of several inches between them. The sulphate of baryta cannot, therefore, have been injected into these fissures in a molten state after the consolidation of the rock. Baryta was not detected in the substance of the rock itself, which, when dissolved, after fusion with carbonate of soda, gave no precipitate with diluted sulphuric acid. This and the other rocks of which analyses are here given contain hydrofluoric acid, which cannot be completely eliminated by heat; after having been ignited until fusion of the rock had commenced, the presence of fluorine was still detected in it by fusion with bisulphate of potassa. This rock is uncrystallized, but it passes into syenite and mica schist.

II. Syenite, from the same place. The crystallization is imperfect, and some anhydrous peroxide of iron remains in an earthy state.

III. Amorphous rock from the same place, passing into mica schist. It differs from I. in having a smooth surface when fractured, and in being more of a slate colour than the latter. After being dried by evaporation at 212° Fahr., it gained 0·87 per cent. in weight by subsequent ignition, owing to the peroxidation of the iron.

IV. Hard mica schist, into which the above passes. The mean composition of these two agrees more nearly with the uncrystallized rock in the quarry (I.) than the composition of either of them taken separately. There may have been an interchange of elements, some of the iron and magnesia in the mica of IV. having been derived from III., which retains a larger proportion of alumina, lime, and manganese.

V. Brownish grey rock, from the summit of the same quarry, uncrystallized, disposed in beds with vertical cleavage, similar to the rock below.

VI. Syenite from the same place, similar to II., but more fine grained.

VII. Greyish black rock, disposed in rectangular prisms, on the west slope of the North Hill, at a higher elevation than the preceding, and to the S.W. of them, quite uncrystallized, but passing into syenite.

VIII. Syenite, associated with the above; its chief constituent is hornblende. It is more perfectly crystallized than the syenites before mentioned (II. VI.) Thin veins of epidote are deposited in its crevices. The portion of the syenite of which an analysis is here given was taken from a part of the rock which did not contain any admixture of epidote.

Comparing I. and II., III. and IV., V. and VI., VII. and VIII., we find instances of the transition of rocks from the amorphous to the crystallized state, without any material change of composition; and as syenites and mica schists similar to these are found in other parts of the hill, we may thus trace them to their source, even where no amorphous rocks occur in their vicinity.

IX. Greyish black uncrystallized rock, forming rectangular prisms, south of the large quarry at North Malvern. It contains much hydrofluoric acid, and is very fusible. There is only a trace of soda.

X. Greyish black rock, forming a remarkable vein in the syenite north of the footpath from Great Malvern to West Malvern, overlooking the Westminster Arms. The vein dips slightly southward; it is about twelve feet long, and from a few inches to more than a foot deep; broken by a fault towards the north. Near the syenite it is marked by epidote; the interior is hard, compact, and uniform.

XI. A similar rock, taken from the middle of the railway tunnel under the South Hill.

In these two rocks, the ratio of the oxygen of the silica to that of the bases is nearly 3 : 2. There is less silica in VII., and still less in IX. Yet these four rocks closely resemble each other in appearance. The rock containing least silica (IX.) has most water, and is probably most altered from its original composition; its alumina is reduced in quantity, and its soda nearly removed.

XII. Rock forming rectangular prisms, consisting of fine-grained hornblende and epidote, from the west slope of the North Hill, near the summit, overlooking the hill road north of Elrington Cottages.

XII. Red rock, from a steep mound overlooking the south end of the road to Elrington Cottages. It is very hard, and spotted with epidote, and there are minute scales of gold mica. There is only a trace of hydrofluoric acid. All the iron is in a high state of oxidation. It passes into a coarse rock, containing much quartz; and in one place, towards the south, it is associated with a rock which runs in parallel bands, about four inches wide, and five inches apart, resembling metamorphic sandstone.

XIV. Rock found in rectangular prisms in a boss of trap near Fowlet Farm, of a greenish-brown colour, uncrystallized, with numerous cavities, which are partially lined with epidote. In the furnace, when allowed to cool rapidly, it fused into a black glass, like obsidian.

XV. Greyish black amorphous rock, from a trap boss near Bransill Castle. The cavities are filled with carbonate of lime.

XVI. Rock from another boss near Bransill Castle, in which are embedded velvet black portions, apparently of augite, but with no distinct crystallization.

XVII. Similar rock, from a boss of trap, in a field of black shale south of Fowlet Farm. It contains a little glassy felspar. The quantity of hydrofluoric acid is unusually large.

XVIII. Grey trap rock, from a boss near Rowick, containing magnetic oxide of iron.

XIX. Trap rock from the south-west base of the Ragged Stone Hill. The iron in the part of the rock which is soluble in hydrochloric acid is in a low state of oxidation; the insoluble portion contains a little peroxide.

XX. Trap from the north-west side of the West Ragged Stone. The portion soluble in hydrochloric acid contained magnetic oxide and protoxide of iron; the insoluble portion, peroxide.

XXI. Rock from the same place, after passing over the sandstones, and immediately before arriving at the trap of the hill. It contains black granules, like gunpowder. There are in it hydrofluoric acid and a little potass, but no soda; and it seems to consist of minutely divided hornblende and quartz.

On Nerve Force. By H. F. Baxter. (Continued from Vol. XII. p. 39.)

In a former paper, published in the "Edinburgh New Philosophical Journal,"[*] I endeavoured to ascertain whether any manifestation of current force could be obtained in nerves during nerve action. My experiments led to a negative conclusion; neither could I obtain any direct evidence of an *increase* in the nerve current *during* nerve action; but whether any evidence of a *conversion*, as it were, of the electric force of the nerve into nerve force during nerve action existed, remained as an open question. My object, however, on the present occasion, will be to inquire whether we can obtain any evidence of an inductive effect of one nerve upon another nerve during nerve action.

Claude Bernard[†] says, "Du Bois Raymond has proved that in electrifying the nerves, an electro-tonic state is produced, which does not act upon the muscles, but upon the nerves which lie in the vicinity; they are liable, in fact, to receive a part of the superabundant electricity condensed in the neighbouring trunk. Let it be supposed, for instance, that a current passes through a nerve, which lies in contact with another divided nerve, contractions will appear in the muscle connected with this latter branch, although no direct impulse has been conveyed to it; the proximity of another nerve, stongly impregnated with the electric fluid being sufficient to create a participation in its effects."

---

[*] New Series, July 1860. I may also refer to my Essay on Organic Polarity, published by Churchill.

[†] Medical Times and Gazette, August 17, 1861.

M. Chauveau,* in some valuable and interesting papers, has shown that when the nerves of two separate limbs are placed parallel and in contact with each other, upon stimulating one of them the limb of the other would contract. The effects varied according as the electric current traversed the nerve, and it was necessary to employ electricity.

Having failed in my former experiments in obtaining any evidence of an *increase* in the electric condition of the nerve after being submitted to electrical action, the opinion expressed by Claude Bernard, that "one nerve received a part of the superabundant electricity condensed in the neighbouring trunk," does not appear to me to be supported by sufficient evidence, but would rather confirm the notion that some inductive effect might then be produced.

In the following experiments the nerve of the limb *primarily* stimulated will be designated by the letter *a*, and the nerve of the other limb,† in which any inductive effect may be supposed to take place, such as would be indicated by muscular contraction, will be designated by the letter *b*.

M. Chauveau dissected out the sciatic nerves of a frog, removed the thigh, leaving the nerve connected with the leg only; then placing the nerves parallel to each other and in contact, stimulating a portion of the nerve *a* by means of a current from a small voltaic circle between the leg and the part in contact with *b*, an effect was produced on the nerve *b*, as indicated by muscular contraction of that limb. The effects varied according as the nerves were placed in contact with each other, whether in the same direction or reversed, and according to the direction of the current, whether ascending or descending. The distance between the stimulated portion of

---

* Journal de Physiologie, Juillet et Octobre 1859, Janvier et Avril 1860.

† The limb *b* has been usually designated as the *rheoscopic* or *galvanoscopic* limb. I shall avoid using either of these terms on the present occasion, inasmuch as my object is not to ascertain whether any electrical effect is observed, but whether any effect like nerve induction takes place, just as we obtain an inductive effect when a closed metallic circle is placed in the neighbourhood of another closed circle traversed by an electric current.

a and *b*—the extent of contact between *a* and *b*—were points necessary to be attended to.

As my experiments confirmed in the main the results obtained by M. Chauveau, it will be unnecessary to enter into a detailed account of them, especially as the effects observed appear to me to be referable to other causes than the one sought for—viz., an inductive effect. They were conducted in the following manner.

The nerves of the thigh and pelvis were carefully dissected out with the leg remaining. With the two limbs thus prepared and separated, a long portion of the nerve *a* could be placed in contact with *b*, the limbs being in the same direction or reversed, or the nerve *a* was coiled round the nerve *b*. Whenever the spinal extremity of *a* was stimulated by a small voltaic circle, such as a piece of zinc and copper wire, and the end of *b* in contact with *a*, although at some distance from the excited extremity of *a*, contractions were produced in both limbs, provided that both limbs were fresh and easily excited, and the limbs in the same direction. If the nerve *b* was arranged with its spinal extremity near the leg of *a*, the limb being in the reversed direction, contractions were occasionally produced in *b*. If the spinal extremity of *b* was bent out so as not to be in contact with *a*, then the effects, the contractions of the muscles of *b*, were not so readily produced. If a stronger exciting force was employed—viz., the electricity from one of Grove's middling-sized cells, the effects were more readily obtained, but of the same character.

Instead of exciting the nerve *a* by means of electricity other steps were adopted, such as the point of a needle, or a piece of glass, or by applying solution of caustic potash, or of common salt, to the nerve. Under these circumstances contractions were readily excited in the limb *a*, but rarely in *b*.

I now prepared two frogs with the limbs attached to the spinal cord; the nerves were dissected out, and the pelvis and thighs removed. The nerves *a* were coiled round or placed in contact with the nerves *b* as before, and I could thus act upon four limbs together or separate, or I could make one limb contract and its corresponding limb contract also by reflex action. In this experiment I very rarely obtained any contraction in the limb *b*.

From the results obtained in all my experiments, I cannot come to the conclusion that any inductive effect was obtained indicative of *nervous induction;* and although it sometimes happened that an effect did occur which might lead one to conjecture that such might be the case, I must nevertheless confess that the evidence was not sufficiently strong to justify me in coming to that conclusion. I shall now briefly recapitulate the circumstances to which the results appear to me to be due.

The contractions observed in the limb *b* may arise from various circumstances—those which are *extrinsic*, and from those which are *intrinsic*. The former are—1*st*, The *nerve-current*. The position of the nerves may be so arranged that the nerve-current is either made or broken from the slightest movement of one of the limbs,—a circumstance which is very likely to occur during the contraction of the muscles. The nerve-current may not arise from or be excited at the extremity of the nerve, but at one of the divisions of the trunk of the nerve, which went to supply the muscles of the thigh.

2dly, From the electricity evolved during the contraction of the muscles in limb a—this electricity being conducted by the nerve itself, just as we find it to occur when the nerve is placed on the contracting muscle. That electricity evolved during the contraction of a muscle may be made to traverse a circuit not composed of animal matter, has been shown by Matteucci; and some experiments of my own have led me to similar conclusions.

3dly, From the contact of heterogeneous substances. If a portion of muscle or some blood be in contact with either of the nerves, we may have a current of electricity developed due to the contact of heterogeneity, or to the muscle itself producing a muscular current. It is requisite to pay particular care and attention to the nerve at its junction with the leg. A muscular current may be easily generated at this spot.

4thly, From the electricity employed to arouse the contractions in limb, a. If the nerve *b* be near to the excited portion of *a*, contractions are readily produced in *b*. This effect I refer to the electric influence extending to the nerve *b* being conducted by *a* to *b*.

5thly. The slight and occasional effects which cannot be referred to either of the four previous circumstances may be referred to a change of condition (electric) in the nerve *a*. The effects are too rare to be referred to a definite and permanent cause, such as nerve-induction, and too uncertain in their production to be considered as cause and effect, and are evidently the result of some occasional disturbance in the conditions of the experiment. That the electric condition of the nerve is altered when the nerve is irritated mechanically or chemically is easily shown by the galvanometer, by a decrease in the nerve current; and as the effects may occur when electricity is not employed to excite the nerve *a*, I cannot see how they can be referred to "a part of the superabundant electricity condensed in the neighbouring trunk." I shall state other arguments against the supposition of these effects being the result of nerve induction; but prior to doing so, I must just refer to the contractions which may arise in the limb of the nerve *b* independent of those excited by its contact with the nerve *a*, and which may be termed *intrinsic*. These may arise, 1*st*, from the nerve *b* itself becoming dry, as shown in the experiments of Marshall Hall;* or, 2*dly*, from a peculiar state or condition of the limb itself, as may be seen in frogs during the period of spawning, when tetanic contractions are easily produced in the muscles. How far this tetanic state is due to the muscles or to the nerve it is difficult to say; but the fact itself must be taken into consideration, when using the frog as a test of any extrinsic influence.

Thinking it possible that some inductive effect might occur with an electric current, I passed a current from eight of Grove's middling-sized cells parallel to the sciatic nerve, in both directions and transverse to it, but without obtaining any effect when the circuit was made or broken. Matteucci† has also performed a similar experiment without obtaining any result.

---

* Edinburgh New Philosophical Journal, April 1848.

† Philosophical Transactions, 1845, p. 316.

Although these experiments have led to negative conclusions, we must not despair of obtaining more correct views in regard to nerve force. If we can only show that nerve force is not electric force, one great point will be gained; for nothing can be more injurious to the progress of sound knowledge than the confused notions which arise from the employment of terms which are apt to convey erroneous ideas. I will now endeavour to state as concisely as possible the views which I have been led to entertain in regard to nerve force; and however confident I may feel of their truth, I shall not consider them as peculiar to myself, or even that they are not open to remark.

Nerve force I believe to exist in a state of tension. It is not generated in one part and transmitted to another, but associated with the nervous tissue, and the impulse excited at one point is transmitted to another. Its action is not like that of a current of electricity, which depends upon its increase at the terminals, but bears a stronger resemblance to that of a magnet; its action is accompanied not by an increase but by a decrease of its power; the force is lowered, not raised, during nerve action. We have not any evidence at present to show that nerve force extends to a distance like magnetic force, nor can we obtain any inductive effect, as we do with a current of electricity. Now, this may arise from our not being able to *increase* nerve force. Nerve force is so intimately connected and dependent upon nutrition, the one being increased as the other is exalted or increased, that the only mode apparently of increasing nerve force is by exalting the nutritive actions. With regard to the dependence of nerve force upon the electric force, as it exists in the nerve, the latter in this respect is similar to all the other tissues; they all possess what may be termed an electro-tonic state, and I do not think that we have been enabled as yet to obtain any definite evidence of a *conversion*, as it were, of the electric force associated with the nerve into nerve force. The electric force may only indicate one of the conditions, a normal condition of the tissue; and therefore I cannot help considering it as somewhat objectionable in applying the term electro-tonic to the nerve, if it be intended thereby to indicate any peculiar state of the nerve, or that nerve force is nothing more nor less than this electro-tonic state of the nerve. This is reducing nerve force merely to electricity. And with regard to the evolution of electricity in the fish, and during muscular contraction, nerve force is not converted into electricity; the electricity pre-exists in the muscular tissue and in the electric organ, as has been recently shown by Matteucci.* Nerve force and electricity are not convertible terms; and although no force can affect another without itself being affected, we are not justified in assuming that the reaction is of the same nature as the action. Electricity is evolved by nervous influence, and so far a connection or relation between these two forces exists. An evolution of electric power is accompanied with a loss of nervous power; but that a restoration of electricity to the organ would be accompanied with a restoration of nervous power, does not follow as a matter of course; at the same time, it is a question important to decide. The principle of the *conservation of force* is quite distinct from that of *conversion* of force. The former may be considered as an undoubted truth, the latter a theory: vital phenomena bear evidence to the truth of the former principle, that there is no exhaustion of power without a corresponding restoration. *Nutrition* is the grand restorative act during organic work.

In the application of the principle of the conservation of force to organic phenomena, it has been sometimes supposed that the animal body is a mere steam-engine; that the processes which take place in it are for the express purpose of producing *heat;* that the formation of carbonic acid in the lungs is solely for the generation of heat; that compounds are formed for the purpose of being burned, &c. That the development of heat in the animal body is an important fact no one can deny; its formation and connection with the evolution of carbonic acid in the lungs, and other chemical changes, are subjects worthy of research, so as to ascertain the ratio that one bears to the other; but to overlook the development of other forces which are manifested in the animal body, appears to me to be disregarding some of the most important facts connected with vital phenomena. The animal body is something more than a mere mechanical machine, a mere steam-engine, or a mere chemical laboratory; the changes which take place in it subserve more important purposes, the development and manifestation of more recondite phenomena, which deserve and require much investigation for their elucidation.

---

* Proceedings of the Royal Society, November 1860.

Before concluding the present paper, I shall just refer to the action of electricity upon the nerves in exciting muscular contraction.

It is well known that contractions arise from the development of the nerve-current in the nerve of the limb,—that is to say, that when the extremity of the nerve is bent over so as to touch the side of the nerve, contractions are produced in the muscles supplied by that nerve. This experiment was known in Galvani's time. Contractions are also produced when the circuit is broken. To obtain these effects, the limb must be fresh and the frog easily excited. It is needless to add, that contractions may be produced by mechanical means, such as irritating the nerve with a needle or a bit of glass; also by chemical means, such as moistening the nerve with a solution of caustic potash, or of common salt, or with strong acids: so that electricity itself is not essential for the production of muscular contraction, but it would appear that a *change of state* in the nerve is the essential condition. Although electricity is not necessary for the production of this *change of state* (I am not supposing that the electric state of the nerve is not affected), it nevertheless bears a very important relation to nerve force in the production of this *change of state*, as is manifested in the difference of effects observed in regard to the *direction* of the electric current when made to traverse a nerve. Let us pass a current of electricity from a small voltaic circle along the nerve of a recently prepared frog; if the current be passed either in the *direct* or *inverse* directions, contractions are produced both at the *closing* and at the *opening* of the circuits. After a short time the effects (contractions) are produced only at the *closing* of the *direct*, and at the *opening* of the *inverse* current. I shall not enter upon the different results that are observed at various periods, these have been noticed by Nobili and others, and especially by M. Chauveau. The results of my own observations lead me to believe that, after a short period, a series of constant results is not easily obtained, so that a doubt naturally arises whether any definite law can be laid down in regard to their production at distinct periods; nevertheless the facts, such as I have stated to occur at the *opening* and *closing* of the circuits, will not, I think, be denied; and the question arises, can they be referred to any principle of action? M. Chauveau* and Dr Radcliffe† suppose that muscular contractions are the result of instantaneous currents of high tension, the result of extra currents and induced currents formed at the opening and closing of the circuits. There can be no doubt that the *change of state* produced in the nerve occurs at these periods, and arises from an alteration in the electric tension of the circuits; but I believe also that the *direction* of the current traversing the nerve is of more importance. Let us suppose that we are acting upon a nerve after the first period of the excitability, when the effects (contractions) occur at the closing of the *direct* current, and not at its *opening*; and at the *opening* of the *inverse* current, and not at its *closing*. After the closure of the circuit, when the *direct* current is passing, we obtain contractions; but at its *opening* we then have an *inverse* current (the extra current), but no contractions. After the closure of the *inverse* current, no contractions; at its opening, we then obtain a *direct* current (extra current), and contractions are produced.

M. Chauveau has well pointed out the differences observed under these circumstances, but he speaks of the current as being stronger. Now, according to Faraday,‡ "the intensity and quantity of electricity moving in a current are smaller when the current commences, or is increased, and greater when it diminishes or closes;" such being the case, and if the results were due to high tension, we ought to have a greater effect at the *opening* of the *direct* current than at its *closing*, but experiment leads to an opposite conclusion. At the

---

* Journal de Physiologie, Janvier et Avril 1860.

† On Epilepsy, 3d edit., 1861.

‡ Experimental Researches, vol. i. para. 1107.

closing of the *inverse* current we get no effect; but at its *opening*, when we have the *direct* current (extra current), contractions are produced. From these facts, I cannot but infer that the *direction* of the current is of the utmost importance in these experiments; they go far to show an intimate connection between nerve force and electric force, but at the same time afford no proof of their identity.

The conclusions that are deduced from the foregoing experiments and arguments are,—

First, That no inductive effect is obtained during nerve action upon a neighbouring nerve.

Secondly, The contractions which are observed in the limb *secondarily* excited may arise from various circumstances, which may be divided into those which are *extrinsic* and those which are *intrinsic*. Amongst the former are, 1*st*, The nerve-current; 2*dly*, From the electricity evolved during the contraction of the muscles; 3*dly*, From the extent of heterogeneous substances adhering to the nerve, or from a muscular current; 4*thly*, From the electricity employed to arouse the contractions in the limb; and, 5*thly*, From a change of condition (electric) in the nerve primarily excited. The *intrinsic* are, 1*st*, The state of the nerve respecting its dryness; and, 2*dly*, The state of the animal at the time of the experiment.

Thirdly, No inductive effect is produced upon the nerve when placed in the neighbourhood of a wire traversed by an electric current at the opening and breaking of the circuit.

Fourthly, That, in the application of the principle of *conservation of force* to the organic kingdom, other phenomena besides those connected with the development of heat and chemical action require to be studied; and,

Fifthly, In the action of electricity upon nerves to arouse muscular contraction, the *direction* of the current is of the utmost importance to be attended to.

Observations on the Natural History of the Enemies of the Coffee-Tree in Ceylon. By J. Neitner, Esq., Ceylon.

In publishing these observations (which may be looked upon as a continuation of a general notice of noxious Ceylon insects, published by me in *Stettiner Ent. Zeitung* 1857), I have a twofold object in view: first, the diffusion of a *correct* knowledge of the subject which they embrace amongst my brother planters, and secondly to furnish a contribution to biographical and economic entomology—a branch of the science which is now being daily more and more appreciated. In judging of apparently trivial passages as well as of scientific technicalities, which occur in the text, this must be borne in mind. To those of my brother planters who would have wished for more elementary explanations than space permitted me to introduce, I can strongly recommend "Westwood's Introduction to the Modern Classification of Insects," 2 vols., with numerous woodcuts, as a most excellent and inexhaustive source of information.

The numerical list given below might easily be doubled by minute research in the outlying districts, and introduction of unimportant species. However, such as it is, it holds good for the entire coffee region of Ceylon in general, and for the cluster of districts grouped round the Peacock-hill (my special field of research) in particular. In fact, the brown and white bug, and the black and white grub, are the only universal and important enemies of the coffee-tree. The destructions of Arhines, Limacodes, Zeuzera, Phymatea, Strachia, and the coffee-rat, appear to be of a more local and occasional nature, and are therefore of less importance. The rest of the species are nearly all enumerated for the sake of scientific completeness only. To the gentlemen, both here and in Europe, who have assisted me, I beg to tender my best thanks.

A few statistical notes will not be uninteresting to the reader abroad. The hill region of Ceylon covers an area of about 2000 square miles, is of a somewhat circular form, and its most elevated peaks rise to 8280 feet above the level of the sea. Systematic coffee planting is, from physiological reasons, exclusively carried on in these hills, although irregular native garden-plantations are found everywhere in the island, even close to the sea-beach. The favourite elevation is between 1500 and 3500 feet, but in a few exceptional cases estates descend almost to the foot of the hills, whilst others are situated as high as 5500 feet and more. The number of systematically worked coffee estates, scattered all about these hills, amounts to about 420, divided amongst twenty-eight districts (very widely differing in some instances in physical aspect), covering an area of about 90,000 acres, producing about 600,000 cwts. of clean coffee (worth on the spot about £1,500,000 sterling), and giving employment to upwards of 100,000 persons, chiefly Tamil labourers from the coast of India. This is exclusive of about 50,000 acres of native coffee. It seems that the coffee-tree was brought to Ceylon by the Dutch, about two hundred years ago, but the first estate was only opened in 1825.

I now give a list of the names of the enemies of the coffee-tree and their parasites (in which I have not thought it necessary to adhere strictly to systematic order), and then proceed to detailed descriptions.

List of the Enemies of the Coffee-Tree and their Parasites.

HEMIPTERA.

1. *Pseudococcus Adonidum*, L? (White or mealy bug).
   Parasites: *Scymnus rotundatus*, Motch. *Et. ent.* 1859; *Encyrtus Neitneri*, Motch. *loc. cit.; Chartocerus musciformis* Motch. *loc. cit.; Acarus translucens*, N.
2. *Lecanium coffeæ*, Walk. List. Ins. B. M. (Brown or scaly bug).
   Parasites: *Scutellista cyanea*, Motch. *loc. cit.; Cephaleta purpureiventris*, Motch. *loc. cit.; C. brunneiventris*, Motch. *loc. cit.; C. fusciventris*, Motch. *in litt; Encyrtus paradisicus*, Motch. *in litt; E. Neitneri*, Motch.; *Cirrhospilus coccivorus*, Motch. *in litt; Marietta leopardina*, N. *in litt.; Chilocorus circumdatus*, Schonh.; *Acarus translucens*, N.
3. *Lecanium nigrum*, N. (Black bug).
4. *Syncladium Neitneri*, Rabh. Dresd. Hedwig. 1858. *Triposporium Gardneri*, Berk. J. Hort. Soc. Lond. 1849. A fungus.
5. *Aphis coffeæ* N. (Coffee-louse).
   Parasites: *Syrphus Nietneri*, Schiner *in litt.; S. splendens*,

Dolesch.; *Micromus australis*, Hag. Verz. Wien. z.-b. G. 1858.

6. *Strachia geometrica*, Motch. *in litt.*

LEPIDOPTERA.

7. *Aloa lactinea*, Cram. pap. ex.
8. *Orgyia ceylanica*, N.
9. *Euproctis virguncula*, Walk. *loc. cit.*
10. *Trichia exigua*, Field. *in litt.*
11. *Narosa conspersa*, Walk. *loc. cit.*
12. *Limacodes graciosa*, Westw. *Ent. cab.*
13. *Drepana?*
14. *Zeuzera coffeæ*, N.
15. *Agrotis segetum*, Wien. V. (*Black grub*).
16. *Galleriomorpha lichenoides*, Feld. *in litt.*
17. *Boarmia ceylanicaria*, Feld. *in litt.*
18. *B. leucostigmaria*, Feld. *in litt.*
19. *Eupithecia coffearia*, Feld. *in litt.*
20. *Tortrix coffearia*, Feld. *in litt.*
21. *Gracilaria? coffeifoliella*, Motch. *loc. cit.*

DIPTERA.

22. *Anthomyza? coffeæ*, N. in Motch. *loc. cit.*

ORTHOPTERA.

23. *Phymatea punctata*, D.

COLEOPTERA.

24. *Ancylonycha spec?* (White grub).
25. *Arhines? destructor*, N.

APTERA.

26. *Acarus coffeæ*, N.

MAMMALIA.

27. *Golunda Ellioti*, Gray in Kel. Prod. (Coffee-rat).*

Descriptions and Observations.

1. *Pseudococcus Adonidum*, (White or mealy bug). *Male:* Head rather square, enlarged behind and rounded off at the posterior angles; eyes prominent, black; ocelli two, small, lateral; antennæ nine-jointed, second joint longest, third shortest, four to nine subequal; mouth externally represented by two black knobs resembling blunted mandibles. Thorax ample,

---

* The species marked Motch. *in litt.* and N. *in litt.* will probably be found described in Motch. *Et. Ent.* 1860; those marked Feld. *in litt.* and Schiner *in litt.* probably in Wien. *Ent. Monatsch.* 1860.

oblong-quadrate, enlarged at the shoulders; wings two, ample, two-nerved, hyaline, strongly irridescent, laid straight down the back, half overlapping each other when at rest. Scutellum ample, transverse, rounded at the apex. Abdomen subcylindrical, of shrivelled appearance, with two long anal setæ, which are slighty curled, and of mealy, brittle consistence. The insect is of light dirty-brownish colour and slightly hairy; it is very minute (very much smaller than the females, only about one-half line long), and resembles certain small Ephemeridæ or May-flies.

Female: Apterous, oval, brownish-purple, covered with a white mealy powder which forms a stiff fringe at the margin (one tooth or tuft to each segment on either side), and at the extremity of the abdomen two setæ. The back is laid out in three longitudinal and a number of transverse corrugations, the latter corresponding with the number of segments; upon each of the three longitudinal corrugations, the mealy secretion forms a sort of ridge-cap. The feelers, legs, and promuscis, are of light-brown colour and slightly hairy. The former are setaceous, eight-jointed (the last joint being the longest), nearly as long as the legs and porrected. The promuscis is situated between the anterior pair of legs, having a few hairs, but no sucking bristles at the tip.

The *larvæ* and *pupæ* of the female resemble the perfect insect, but are on a smaller and less perfect scale. In the male pupa wings and anal setæ are rudimental, in the male larvæ absent. These imperfect males rather resemble young Psoci or Aphides, but they carry the antennæ turned backwards, along the sides of the body. The larvæ and pupæ are active, move about.

The insects, in all stages of development, are found all the year round, the propagation being continuous. It appears to me, however, that the males are more plentiful about June and January than at any other season. They affect dry, hot localities, and are found as well on the branches as on the roots of the trees, to about one foot under ground. The eggs are actually laid and enveloped in a white cottony substance; they are oval and of yellow colour. I am not sure that there are not two species in the island, as I find some communities rather flatter and more densely covered with meal. However, these may be local varieties. The white bug of the Ceylon coffee-tree seems to be identical with the species which is naturalised in the conservatories of Europe, and is perhaps a cosmopolite. It is closely allied to the *Pseudoc. cacti* of Linnæus, the cochineal insect. There are several insects in the island resembling the white bug, but being of the size of a sixpenny, and even shilling piece, these belong to the *G. Dorthesia*, and I have generally found the up-country species upon the stem of a laurel, *Tetranthera Gardneri*, Thw.

For general observations on the bug see farther on, after the description of the brown and black bug.

The white bug is preyed upon by the larva of *Scymnus rotundatus*. This is a minute beetle of the lady-bird tribe. as big as a pin's head, black and pubescent. The larva greatly resembles the white bug, and might easily be mistaken for it. It is, however, longer, narrower, flatter, and of a yellow colour, but covered thickly with stiff white hair of the same cottony substance as those of the bug. This covering is occasionally renewed, and is especially thick when the metamorphosis is at hand. This latter the larva undergoes in a thin oval cocoon, to which the white covering of the larva remains externally attached. This larva is very active, and attaches itself to the underside of the bug. I have reared several in March and April, 1859, in empty bottles. "Westwood, Introd.," vol. i. 398, mentions the larva of a Scymnus feeding upon Aphides, and, vol. ii. 443, feeding upon Aleurodes. The larva of the Scymnus is an external parasite, and M. de Motchulsky is wrong in stating that I had discovered it "*dans* le Pseudoc."

The white bug is also preyed upon by the larvæ of *Encyrtus Neitneri* and *Chartocerus musciformis*, two minute Hymenoptera (wasps), the former of yellowish colour and common, the latter black and scarcer. They are only $\frac{1}{2}''$ long. There is also a very minute whitish-translucent mite which is found mixed up with the bug, and no doubt injures it to some extent. I will call it *Acarus translucens*.

2. *Lecanium coffeæ* (brown or scaly bug). *Male:* head transversely ovate-rotundate, narrowed, and square in front; eyes large, black; ocelli two, small, lateral; antennæ nine-

jointed, second joint smallest, third longest, thence decreasing to the tip; mouth as in the male of the white bug. Thorax ample, cordiform, narrowed in front; wings two, hyaline, two-nerved, subcostal nerve dark pink, not folded straight down the back when at rest, but half spread out. Scutellum as in white bug. Abdomen triangular; subcylindrical, of shrivelled appearance, with two lateral points, one central appendage, and two long, thin, white filaments at the extremity. The insect is still more delicate than the male Pseudococcus, of clear, light pinkish-brown colour, slightly hairy; very pretty.

Female: apterous, tortoise-like, yellowish, marbled with grey or light-brown, sub-oval, more or less semi-globose according to age; back with one elevated longitudinal, and two transverse costæ, uneven; split behind, at the extremity of a split bifid anal flab of brown colour; eyes marginal, black: antennæ seven-jointed, third joint longest; promuscis with one long sucking bristle. The old individuals are light brown with a dark margin, smooth, semi-globose, fixed to the branch.

Larvæ of female, with two anal filaments, which are lost in after-life. The larvæ and pupæ of both sexes are active, with the exception of the male pupa, which is plentiful on the underside of the leaves where the long, narrow, oval shell under which it rests is easily discovered. This shell is transparent, and composed of nine plates, three central and three on either side. I have occasionally found the entire underside of leaves covered with nothing but male pupæ, all dead. This species of bug affects elevated (above 3000 feet), cold, damp, close localities, where it is found in all stages of development all the year round, the propagation being, as in the white bug, continuous. As in the latter species, the males seem to be more abundant about June and January than at any other season. The eggs, which are oval and of pinkish colour, are not actually brought forth by the female; but when they are matured the parent insect dies, her whole interior forming one mass of eggs protected by the shell.

This kind of bug is closely allied to the lac-insect (*Coccus Lacca*, K.) of India.

The brown bug is much infested by parasites, amongst which the following are the most common: *Scutellista cyanea*, *Encyrtus Neitneri*, *E. paradisicus*, *Cephaleta purpureiventris*, *C. brunneiventris*, *C. fusciventris*, *Cirrhospilus coccivorus*, *Marietta leopardina*. These are all Hymenoptera of the most minute description, presenting under the microscope the most elegant forms, and, for the most part, the most brilliant metallic colours. The Marietta, for instance, is spotted or ocellated all over black and white like a leopard. They can easily be obtained by putting a bugged branch, cut in convenient lengths, into a bottle, when after some time the little wasps will be found flying about inside, having made their escape from the bugs. The mother parasite lays her eggs amongst the bugs; when hatched, the young larvæ find their way easily to the soft underside of the bugs, where they attach themselves like leeches, and, protected and fed by the body of the bug, remain until they reach the perfect state. A bug thus attacked produces of course no eggs, and, instead of the young bugs, in course of time there escape those little wasps. The shells of the old bugs are frequently found with one or two holes; it is from these that the parasites have escaped. I have seen as many as six larvæ (belonging to different species of Hymenoptera) attached to one single bug. These larvæ can easily be seen on turning up some old bugs with the point of a penknife; they are little, white or yellowish, eyeless and footless maggots, some of which can leap to a considerable distance by doubling themselves up and spasmodically extending themselves again to their full length.

I shall revert to this subject again farther on.

On examining old full-grown bugs, the shells are often found filled, not with eggs, but with a white flaky substance, amongst which the above-mentioned mite, *Acarus translucens*, is seen busy. I have thought that the mite might have been the destroyer of the eggs in these cases, and that the flaky substance were the empty and decomposing egg-shells, but feel not certain on this subject. The planter has another friend in the larva of a kind of lady-bird which feeds upon the bug, viz., that of the *Chilocorus circumdatus* (syn. *Ch. nigro-marginatus*, N. in Motch. *Et.*) This larva is of ashy-grey colour, furnished with black spots and rows of black spines. The perfect insect rather resembles a full-grown bug, being semi-globose, light brown, with black margin round the elytra. There is a variety which is altogether dark-brown. The larva skin splits, but is not thrown off when the insect assumes the pupa state. When the imago, or perfect insect, issues from its double shell, it is white, turns round (head towards tail of skins), and sits in this position upon its former envelopes for twenty-four hours before it moves off. During this time it gains its proper colouring. It is common at all seasons, but especially from March to September, and in all stages of the metamorphosis, the larva generally fixing itself to the underside of the leaf when its transformation approaches.

3. *Lecanium nigrum* (black bug).—The male of this species is unknown to me. The female is shield-like, much larger and flatter than the brown bug, colour from yellowish grey to deep brown and almost black, according to age; sub-oval, back with one longitudinal and two concentric oval costæ on disc, towards the margin slightly corrugated. The shell, seen through a microscope, is found to be composed of minute compartments, like the pavement of a street. Anal slit, and flab as in female brown bug. Old female shield-like, black, with slight longitudinal costa.

Larva, with two long, black anal setæ and projectile tube.

This species occurs alone and intermixed with the brown bug, but it is very distinct and at once recognised. It is much less abundant, and therefore of no importance to the planter. I have not succeeded in raising parasites from it.

In the natural course of my observations, I must now mention a fungus, viz.:—

4. *Syncladium Neitneri, Triposporium*° *Gardneri.*—As soon as the bug has fairly established itself upon a coffee-tree, this latter begins to be covered with a fine black tissue, which upon examination proves to be a fungus of the above name. It comes and goes after the bug—never alone; first it has the appearance of a thin, diluted blackwash, but, rapidly increasing in density, within two or three months it quite covers and blackens the leaves and other parts of the tree, finally almost resembling moss. Its period of growth seems to extend over

about twelve months, when it is replaced by a young growth, or leaves the tree with the bug. When leaving the tree it peels off in large flakes. As the occupation of a coffee or any other tree gives rise to the appearance of a glutinous, saccharine substance—honey-dew (either a secretion of the bug or the extravasated sap which flows from the wounded tree, but more probably a combination of both)—which disappears with the bug, and as the fungus does exactly the same, I have no doubt that its vegetation depends upon the honey-dew. There appears to be some doubt whether there are one or two species of this fungus upon the coffee-tree. The late Dr Gardener sent a specimen to the Rev. Mr Berkeley, the eminent English cryptogamist, who described it as *T. Gardneri*. I sent two years ago, specimens both to Mr Berkeley and Dr Rabenhorst of Dresden, when the latter named it *S. Neitneri*, informing me, upon inquiry, that it was quite different from the Triposporium, having *simple sporæ*, whilst those of the latter are *composite*. Mr Berkeley said that he was not certain whether the specimen I sent him was in a different state or a different genus from his Triposporium. Remembering the extraordinary changes plants of such simple organism as the one under consideration undergo in the course of their development, I should feel inclined to think that Syncladium and Triposporium are one and the same, but am unable to finally decide on this point, which, moreover, is of little consequence. Of more interest is it that Dr Rabenhorst received the identical fungus, at the same time, from me and from a correspondent in Nizza (Nice), where it covers the leaves of the olive-tree in the same manner as it does the coffee-tree here. It would be curious to know whether its development there depends upon honey-dew, as, to all appearances, it does here.

I now add some general observations on the coffee-bug.

Most planters with whom I have conversed on the subject, not being entomologists, appeared to look upon the coffee-bug as something most unaccountable, almost mysterious, entertaining very erroneous and extraordinary ideas regarding it. The fact is that there is nothing whatever unusual or extraordinary about it, excepting the apparent capriciousness with which it comes and goes: now rapidly spreading over a whole estate, now confining itself to a single tree amongst thousands; here leaving an estate in the course of a twelvemonth, there remaining for ever; and so forth. The members of this family of insects (Coccidæ), to say nothing of the entire order (Homoptera), are in many instances of very great economical importance. I have already mentioned the cochineal and lac insects as amongst the most prominent in this respect; but whilst these are useful, there are, on the other hand, others which are an excessive nuisance to the gardener and agriculturist. Foremost amongst these ranks, undoubtedly, the coffee-bug; and the *blight* of the sugar-cane in the Mauritius also belongs to this family (Aspidiotus?). In an entomological point of view, these insects are interesting from other reasons. The habits of the Coccidæ have, consequently, long since been the object of study with entomologists. Westwood (*Introd.* 1840) in his bibliographical reference of the Coccidæ, mentions not less than between thirty and forty authors who have written on this subject. In fact, every general entomologist, from Linnæus downwards, has noticed them. The study was facilitated by the circumstance that there are many species indigenous to Europe.

Although, as above stated, the coffee-tree has been known in Ceylon for about two hundred years, and although systematically worked estates have existed since 1825, the bug does not appear to have attracted attention, that is to say, not to have appeared in large quantities, till about 1845, when, however, it began to spread with such rapidity that, in 1847, a very general alarm was taken by the planters. It will be remembered that about the same time the potato, vine, and olive disease began to become very alarming in Europe. With reference to this comparatively recent appearance of the bug in the island, it has been suggested, that it was not indigenous, but had been introduced with seed coffee from some other country. However, the grounds for this assertion are insufficient, and I consider it as indigenous, seeing that it is found upon many other plants besides coffee: I have seen the white bug upon orange, guava, and other trees, also upon vegetables, beet-roots, &c. The brown bug is still less particular, and attacks almost every plant and tree that grows on a coffee estate, more particularly, though, such as are grown in gardens: guavas, hibiscus, ixoras, justicias, oranges—everything, even weeds. It has also been said that the brown bug came originally from the wild guava (*Psidium pyriferum*) upon the coffee; but this seems to me improbable, because I have never seen the guava bugged in its *wild* state, and I have had very good opportunity for observation. It is, however, not to be denied that the bug gives it a decided preference, when it grows with other trees on a coffee estate. I have already alluded to the *capriciousness* of the bug: why, as is its wont, instead of spreading itself evenly over an estate, as one would expect it to do, it should attack a certain field only, then after a while leave that and go to another, and then to another, and another, it would not be easy to explain satisfactorily. All that is certain is, as I have already mentioned, that the white bug prefers dry, and the brown bug damp localities; and this is to be observed more in detail on any individual estate. The brown bug will be found more plentiful in close ravines, and amongst heavy rotting timber, than on open hillsides. The shifting from place to place depends, probably, upon this predilection of the insect. The bug, of course, seeks out the softest and most sheltered parts of the tree: the young shoots, the underside of the leaves, and the clusters of berries. The injury done by the white species seems worse than that of the brown, but not being so plentiful as the latter, it is of less general importance. The white bug is especially fond of congregating amongst the clusters of berries, which drop off from the injury they receive: trees often lose their entire crop in this manner. The injury of the brown bug seems to have a more general effect, by simply weakening the tree; but the crop does not drop off altogether, nor so suddenly. With white bug on the estate the crop can hardly be estimated; with brown bug it can.

With regard to the nature of the injury a tree receives from the bug, it may be said that a tree thus attacked suffers from *loss of blood (sap), and from partial starvation and suffocation.* In this manner, the bug, by means of its sucker, deprives the tree of its sap, that is its blood and nourishment, after it has entered the organism; whilst the fungus, which never fails to attend upon the bug, with its rootlets and otherwise, closes a vast number of the stomates through which the tree breathes and perspires, thus impeding its respiration. It is, moreover, probable that a tree covered with fungus, being, as it were, placed in the shade, the due decomposition of the carbonic acid of the atmosphere is prevented in such cases, and that the rootlets of the fungus act in a manner very similar to the sucker of the bug. It is not to be wondered, then, that a tree covered all over with bug and fungus should get exhausted. Bug exists on the estates to an incalculable extent; none, I believe, are quite free from it. A thoroughly bugged tree will hardly produce any crop at all. Whole estates are seen "black with bug," that is, with the fungus. Am I wrong in saying that if there was no bug in Ceylon it would, at a rough guess, produce 50,000 cwts. more coffee than it actually does? The value of this quantity on the spot being about L.125,000, this sum would represent the aggregate of the annual loss by bug sustained by the planters. But this is not all: the value of an estate on which bug appears to be chronic is, of course, much less, yielding less crop than that of a clean one.

I have been asked how the bug came to an estate? The eggs, which are a mere dust, are carried about by birds or insects to whom they adhere, or by the wind. If these are deposited in a favourable place they will hatch, and we have then the bug in the larva state. The larvæ in course of time assume a more perfect form, the pupa state, and eventually change into the imago or perfect insect. In the larva state the male and female brown bug are not distinguishable; but in the pupa state the male is very distinct, having all the characteristics of the perfect insect about it. In the white bug the male and female larvæ and pupæ are always distinct. The perfect males either do not feed at all, or if they do, it is probably upon honey-dew, for having no sucker they cannot feed like the females. The number of eggs produced by a female brown bug is about 700. Those of the white bug are not so numerous. The species of bugs indigenous to cold climates produce but one generation of young annually; the propagation in our species being *continuous*, accounts, in a great measure, for their abundance here. The males are so delicate and minute that they will hardly ever be observed on the trees, but they are easily reared in bottles.

The brown bug is dreadfully infested with parasites, especially the larvæ of minute Hymenoptera. The individuals attacked are generally full-grown females, probably because they are the most juicy. The parasites are very numerous: not only have I found as many as six preying upon a single bug, but I have actually had difficulty in finding a sound old female for examination, and (upon counting) repeatedly found that from 50 to 75 per cent. were infested with parasites. If it be remembered that each of these would have produced some 700 young, it becomes at once clear that the parasites are of enormous benefit to the planter. Indeed, it is a question whether coffee-planting could be carried on without them; for these parasites, the females of which, by a benevolent design of nature, greatly preponderate over the males, are almost the only check upon the bug we have, no human ingenuity having hitherto devised a remedy that could be *profitably* employed either as a preventative or a cure. Numerous, indeed, are the suggestions which have been made on this point, but none have succeeded. The remedies resorted to at home by gardeners to destroy bug in conservatories or upon fruit-trees cannot be thought of here upon 90,000 acres of coffee, each acre containing from 1200 to 1600 trees. Some six years ago it was suggested to introduce the large red tree-ant of the low country (*Formica smaragdina*, Fab.)* on the coffee-estates, in the hope that it would destroy the bug. The suggester did not understand the relations actually existing between bugs and ants; besides, the remedy was worse than the evil, these ants being so fierce, and their bite so painful, that the coolies would not go amongst the trees as long as they were there. Our bugged coffee-trees are visited by other species of ants commonly enough, but they do not drive away the bug: by means of tickling or caressing with the feelers, they induce it to emit a certain saccharine fluid which it secretes, and this the ants eagerly eat, but they do not eat the bug itself. The latter act of ungratefulness may, and does, occasionally take place, but they do not seek the bug for this purpose. It is an old remark of Linnæus, that the Coccidæ and Aphides are the milch-cows of the ants. Quite recently I found under the bark of a dead jungle-tree a colony of ants and white bug, the latter being, to all appearances, kept and fed by the former; and I can testify to the excellent condition the bugs were in. It may be said that the bugs might be otherwise injured by the visits of the ants, and die out, but there is not sufficient evidence for this assertion.

---

* The specific name applies to the female, which is large and green; the male is small and black; the red individuals usually found in the nests (and of which there are several sizes) are the neuters.

Rubbing off the bug by hand has been tried, but it can only be attempted upon young trees without crop. The quantity of bug destroyed by this simple means is certainly immense, but I am afraid that upon the whole the effect is but trifling.

The application of tar to the roots has been suggested, it being said that, taken up into the system of the tree, it throws off the bug. Although hitherto no important results have been achieved by carrying it out, this idea strikes me as a *very valuable one: it is through the root of the tree the evil should be dealt with;* but a substitute for tar should be sought for, more powerful, and more deadly to the bug, but at the same time equally harmless to the tree.

But generally, nothing at all is attempted to get rid of the bug, and under existing circumstances it is perhaps as well. High cultivation seems to have the effect of throwing it off also, and would be a very desirable cure if it could be carried out universally.—And suppose an estate did get rid of the bug, would it not soon make its appearance again from a neighbouring plantation? As the bug seems to depend upon *locality* —as long as the physical aspect of that is not changed, what can be expected? unless it were by some cheap means destroyed simultaneously on all estates. I should think that if pattenas, which are open, warm, airy localities, were cultivated (which they can be, as experiments on a large scale tried at Pusselaw show), the brown bug, which is, after all, the bug *par excellence*, would not find them so favourable to its existence as the localities in which at present it thrives best; but again the white bug might find them very suitable places.

Or, perhaps, if estates, as a rule, were made smaller than they generally are, and if the reduction in acreage were counterbalanced by a higher system of cultivation, *universally* carried out, bug would not be so plentiful as it is now.

I regret that I have nothing of more importance to say on this interesting subject.

It has been mentioned to me that the bug was subject to a disease—a white covering forming over and destroying it. This is simply mould. I do not believe that it ever attacks live individuals; but at very wet times and in very close places it may cover the old fixed females: the active part of the community would, one should think, move off. The black fungus also overruns old females or their empty shells.

Westwood, "Introd.," vol. ii. 445, 446, says that the ocelli are wanting, and the mouth is completely obsolete in the male Coccidæ; also that the male pupa is inactive, and covered with a pellicle. From the descriptions given above, it will be seen that my observations differ from these statements: the male pupa of *L. coffeæ* is as described by Westwood, but that of the *P. adonidum* is active. Ocelli and mouth are both very distinct in either species. I have not succeeded in catching a male brown bug in the act of emerging from its shell, although I much wished to ascertain whether it was done in the curious manner mentioned by Westwood.

With this I shall dismiss the coffee-bug, trusting that I have not dwelt too long upon it already.

5. *Aphis coffeæ* (Coffee-louse).—*Both sexes:* naked, shiny pitch black, with whitish rostrum, antennæ and legs, and greenish abdomen. The rostrum reaches to beyond the base of the second pair of legs. The antennæ are seven-jointed, the first, second, and sixth being short, the rest long; the two basal joints are black, the rest whitish, black towards apex. Legs with femora and tarsi nearly black, tibiæ nearly white, hind legs with base of tibiæ slightly curved. Male four-winged, with black stigma in the upper ones. Female apterous. Abdomen in both sexes two-corniculate, and with an anal tube. Size middling. Young individuals light coloured.

The insect just described is found in larger or smaller communities upon the young shoots and on the underside of the leaves of the coffee-tree. Its presence in large numbers produces honey-dew and syncladium, as in the case of the bug. The procreative power of this family of insects (Aphidæ) is well-known, and unequalled in nature: from *one impregnation* nine fruitful generations of females have been produced in three months; in another instance eleven generations in seven months; in a third instance they continued to propagate for four years! (Westwood.) The eggs being hatched in the body of the mother-insect, the young come forth alive. Such productiveness, however, does not appear to exist amongst the *A. coffeæ;* at all events the communities are generally small, and their injuries of no consequence. But a species which feeds upon the orange and citron-tree is much more productive. From the anal tubercles a saccharine fluid is discharged of which the ants are very fond, as in the instance of the Coccidæ.

The *A. coffeæ* is subject to the attacks of various parasites: *Syrphus Neitneri, S. splendens.* These are two large flies belonging to the family, the members of which, from their resemblance to bees and wasps, might be called "bee-flies." They rather resemble each other, are of dingy colours, black, abdomen variegated with whitish-yellow bands; the former is pubescent, the latter smooth; they are both $\frac{3}{8}''$ long and $\frac{6}{8}''$ across the expanded wings. Their larvæ devour the Aphides: these are soft, unsightly, eyeless and footless worms, narrowed on one end, $\frac{1}{4}''$ long when full grown. That of the *Syrphus Neitneri* is brown, with a lighter dorsal mark; the segments are drawn out into scale-like knobs, which form a ridge along the centre of the back. That of the *Syrphus splendens* is green, with a whitish dorsal mark. They make immense havoc amongst the Aphides, being so voracious that in twenty-four hours they increase double their volume. The pupa is pear-shaped, resting within the larva skin for eight days, when the perfect insect comes forth.

Another enemy is *Micromus australis.* This is a pretty little insect allied to the tribe of the ant-lions. Feeding upon plant-lice, the larvæ have been called "Aphis lions," but from their shape they might more appropriately be styled "Aphis Crocodiles." This larva is about $\frac{5}{16}''$ long, narrow, depressed, tapering towards both ends, lightly covered with white hair. It is of brownish colour, sides, dorsal line, and under-sides white. It is very active and voracious, and has a pair of enormous sickle-shaped jaws, and long slender palpi and feelers. The former are distinctly three-jointed, the last joint being very long, and the whole palpi as long as the mandibles. Between head and throat there is a distinct neck. The larva encloses itself in a light cocoon, in which the pupa rests for two weeks, when the perfect insect makes its appearance. This latter is very delicate, brownish, with green eyes. The eggs of these insects are deposited upon leaves, each egg being furnished with a long thin peduncle, thus resembling pins or certain fungi.

There are several minute Hymenoptera parasitic upon the *Aphis coffeæ*, but I am unable to give their names.

6. *Strachia geometrica.*—This is a bug, but of a different description from the brown and white bug, to which it bears but little resemblance. It is oblong-oval, argulated, plump, $\frac{5}{16}''$ long by $\frac{3}{16}''$ wide, of yellowish colour, marbled on the upper-side, with grey and orange. It is allied to the so-called green or fœtid bug.

Mr Alexander Brown received this insect from Badulla and kindly forwarded it to me. It feeds upon the juice of the young berries, three per cent. or more of which were said to have been damaged from this cause. This is the only instance of coffee suffering from this insect that has come under my notice. However, allied forms are found both here and in Europe, doing sometimes considerable damage to vegetables by destroying the buds. There is no fear of the insect ever becoming a *serious* nuisance on coffee plantations.

I now come to the enemies of the coffee-tree belonging to the order of the Lepidoptera, the larvæ of which, being entirely dependent upon the vegetable kingdom for their sustenance, do more or less injury to the horticulturists and agriculturists of every country. Fortunately, although I shall mention fifteen different kinds (a number that might easily be doubled) that feed upon the coffee-tree, there are but two or three which do any serious injury.

7. *Aloa lactinea.*—Caterpillar about 2″ long, black, thickly

covered with long brown hair, resembling the so-called "woolly bear," or caterpillar of the *Arctia caja* at home. It is found during the dry weather, weaves an underground cocoon of earth and hair in which the chrysalis rests for two months, when the moth comes forth in July or August. This latter is 1″ long and 2¼″ across the expanded wings, of pure white, edged with red, and a few black marks on the wings; the back of the abdomen is yellow, variegated with black. It is also found upon the Eastern Islands; here it is by no means common.

8. *Orgyia ceylanica.*—Caterpillar 1½″ long, brown, underside and head reddish, covered with yellowish hair, two long slender tufts of dark hair on either side of the head like horns, and another behind like a tail, four short, stiff, white tufts upon the anterior part of the back, and two similar ones on either side. Not uncommon from October to December; spins a thin cocoon, in which the chrysalis rests for two weeks. The female moth is an ugly, sluggish, maggot-like insect, with rudimental, whitish, scale-like wings; it is of dirty, yellowish colour, covered with fine black hair, rather thickly towards the extremity of the abdomen and the sides. It is ⅝″ long. The male, on the contrary, is a lively little fellow, ¾″ across the wings, brown, variegated with a little black and white, rather common during the beginning of the hot weather.

9. *Euproctis virgencula.*—Caterpillar hairy, black, variegated with red spots, ¾″ long; from February to May spins a light cocoon, in which the chrysalis rests for two weeks. Moth 1¾″ across the wings, of pure white colour, with black eyes, back of abdomen slashed with black, large yellow tuft at the extremity. During the dry weather rather common upon the pattenas, which alternate with the plantations.

10. *Trichia exigua.*—Caterpillar from September to December, ½″ to ¾″ long, brown above, grey below, variegated with red and yellow lines and dots, hairy, each segment with two short tufts, behind head two fleshy earlike protuberances, a haunch upon forepart of back. It spins a light cocoon, from which, after two weeks, the moth escapes. This is 1″ across the wings, the upper ones of which are yellowish grey, with

some yellow spots, the lower ones yellowish. It is not common. The caterpillar is also found upon orange and other trees.

11. *Narosa conspersa.*—Caterpillar ⅝″ long and ⅜″ wide, oval, onisciform, transversely corrugated (2) longitudinal dorsal costæ, margin flat, legs retractile, yellow. From August to November encloses itself (often in a single night) in an entire, strong, small, oval, cartilaginous, white cocoon, with a circular brown spot on one end, which is commonly seen affixed to the coffee leaves. The moth, which is rather common during the dry weather, is very pretty, and often flies into rooms at night. It measures 1¼″ across the wings, the upper ones of which are marked like a tiger, yellow and brown, the lower ones being yellow. The caterpillar keeps to the underside of the leaves, and is not often seen. It feeds at night.

12. *Limacodes graciosa.*—Caterpillar from June to August, 1″ long and 3′ broad, more so in front, less behind; back of opal-whitish colour, sides greenish, the former with three broad, green, longitudinal stripes edged with darker green, four rows of glands covered with spines, four of which in front and two behind are tipped with brown, four lateral black spots near anus. Head brown, retractile. Ventral and anal feet abortive. Encloses itself under a thin tissue, in a strong, oval cocoon, or rather half-cocoon, the lower side being formed by the material to which it is affixed. The chrysalis rests from the middle of August to the middle of October; it is short, plump, oval, and its skin slightly drawn out of the cocoon when the moth escapes. This latter is strikingly pretty, 1½″ across the wings, of fine green colour above, middle of thorax, shoulders, and broad margin behind, rich chocolate brown, lower wings light grey-brown, rest of body dark brown. Westwood (*Cab. Or. Ent.*) is not correct in what he says about the male; this latter is like the female, but smaller, 1″ across the wings, the antennæ are two, pectinated from the base to the middle, whilst they are simple in the female. Both sexes have two green spots on the lower side of the thorax, which Westwood does not mention. Mr Evatt, who kindly sent me the caterpillars of this insect from Ambanpittia, writes that they are very active in destroying the leaves of the coffee-trees in that part of the country; that they

disappear sometimes, but invariably return, and prefer fine young coffee in sheltered places. I have also heard of them from Ambegamoa.

13. *Drepana.*—I only mention this scarce insect on account of its curious caterpillar, which is occasionally met with upon coffee. This is about 2″ long, and as thick as a moderate goose quill, naked, occiput conical, a horn upon the anterior part of the back, anal feet wanting, body abruptly semi-truncated behind, but drawn out into a tail of considerable length. It is of brownish-purple colour, variegated with lighter patches on the sides in front, and grey rings on the tail. It resembles the caterpillar of the puss and kitten moth of England. The moth, of which I have no exact description (all my specimens having been lost in the Alma) is, if I remember rightly, about 1½″ across, dark bluish-grey above, and brownish below.

14. *Zeuzera coffeæ.*—This insect is of more importance to the planter, as it destroys many trees, young and old, the caterpillar eating out the heart; for this purpose it generally enters the tree 6″ or 12″ from the ground, ascending upwards. Fortunately it is not abundant. It resembles the caterpillar of the goat-moth of England, is 2″ long, and as thick as a goose quill, nearly naked, of yellowish colour, back red, head thoracic, and anal plates blackish; when full grown the colours are light and dirty. The sickly drooping foliage, and a heap of globules of conglomerated wood dust at the foot of a tree, soon indicate that the caterpillar is carrying on its destructive work inside. The chrysalis rests three months, and its skin half protrudes from the hole when the moth escapes, which is about February. The moth measures 1¾″ across the wings, which are white, spotted with steel-blue, the upper ones with one large spot and numerous series of small ones, placed in rows between the nerves; the lower wings are less spotted. Thorax with four spots near margin. Abdomen variegated with blue. Legs blue, second pair with white femora, third pair with white femora and tibiæ.

15. *Agrotis segetum* (Black Grub).—The larva of this moth is the well-known and very destructive "black grub." It is 1″ long, and as thick as a goose quill, blackish, with black head

and lateral dots, nearly naked. It is most abundant from August to October. The chrysalis rests four weeks in the ground, and the moth comes forth in November and December. The latter is 1¾″ across the wings, of clouded, dark grey-brown colour above, with whitish posterior margin to upper wings; lower wings, abdomen, and legs, whitish-grey. The caterpillar is very common and injurious, whereas the moth is scarce. The former lives in the ground, but comes forth at night to feed. It attacks not only coffee-trees, but all sorts of vegetables and flowers, being consequently a great nuisance in gardens as well as in the field. I believe they eat everything that is artificially raised, despising grass and weeds. I have lost many valuable seedlings in my garden through them, and have seen as many as six of them engaged upon one endive plant. On a neighbouring plantation they effectually put a stop to the cultivation of potatoes. It only attacks young coffee-trees, gnawing off the bark round the stem just above the ground. Should the trees be very small, they are bitten right off, and the tips sometimes partially dragged under the ground, whence the grubs may easily be dislodged. The damage they thus do to young plantations is often very considerable. I lost myself, in one season, in certain fields, as many as twenty-five per cent. of the young trees I had put out, through them. They generally appear only in certain fields, not all over the estate. A little lime put into the ground with the young plants is said to keep them off, which I can easily believe; but one would think that the ashes of the recently burned forest would be sufficient to do so.

The insect is by no means confined to Ceylon, its ravages being well known in India, at the Cape of Good Hope, and in Europe; probably it occurs in many other countries. Its name, *A. segetum*, indicates the nature of its ravages in Europe—it injures the grain crops, but there, as here, almost any agricultural produce is welcome to it. I saw a notice in a recently published paper of its destruction of the beet-root, which is very extensively cultivated on the continent of Europe.

16. *Galleriomorpha lichenoides.*—This is a little moth ⅝″ across the wings, of marbled dark greyish brown colour forward,

lighter behind, which is occasionally found upon coffee, where its larva feeds.

17. *Boarmia leucostigmaria.*

18. *Boarmia ceylanicaria.*

19. *Eupithecia coffearia.*

These are three insects belonging to that family of moths, the caterpillars of which, from their way of moving (like leeches), are called loopers or geometricians. The caterpillars, which are about 1¼″ long, and rather thinner than a goose quill, are evidently meant by nature to resemble, for their security, small twigs, and this they do to a very great degree. The colour of that of the *B. ceylanicaria* is, when young, dark, when older, light grey, marked with dark patches and stripes along the sides, and there is a swelling about the neck and the tail. When at rest they stand straight on end (as leeches also sometimes do), and resemble twigs very closely. The moths, which are of delicate and slender make, are found sitting with expanded wings on trees or the walls of houses. They are found from September to December, but are anything but abundant. The coffee-tree is not the only one upon which the caterpillars feed.

The *B. leucostigmaria* is rather a handsome moth, both pairs of wings being greyish-white, beautifully fringed, and marked with dark lines and red pencilling; below both are marked with a large black stripe. It measures nearly 2″ across the expanded wings; and the antennæ of the male are slightly two-pectinated to within one-fourth of the tip.

The *B. ceylanicaria* is smaller, yellowish-grey, marbled with brown. The *Eupithecia* is still smaller and still darker.

20. *Tortrix coffearia.*—The larva is ¾″ long, 1½‴ thick, nearly naked, greenish, head and thoracic plate brown. It is found nearly all the year round, not exclusively upon coffee, but also upon a variety of garden plants, the leaves of which it draws together, residing inside. The moth is 1″ across, shaped like a perpendicular section of a bell, light brown, clouded more or less with a darker tint of the same colour. It is not at all common.

21. *Gracilaria coffeifoliella.*—This is a moth of the most minute description, measuring but 1‴ in length, and 2‴ across

the expanded wings; it is of blackish colour above, with a few silvery spots, and greyish below. Its larva mines the coffee leaves, and the ugly white lines and blotches so frequently and at all seasons seen upon the leaves are its work. It gets under the epidermis, and eats out the inner parts of the leaf. The larva is $2\frac{1}{4}'''$ long, yellow, flat, naked, undulated at the sides, tapering towards either extremity, eyeless and footless. The body consists of fourteen segments including the head; this latter is brown, pointed at the extremity, and one half retractile; it is furnished near the extremity with two antennal appendages, each with three hairs at the tip; the jaws are large and quite free at the extremity of the head, mooring between two large reniform lips, which gives the head a curious appearance. The penultimate segment is the smallest of all, and furnished with two spurs pointing outwards. The chrysalis is $1\frac{3}{4}''$ long, blackish in the middle, and yellow at the extremities; the head finishes in one, and the tail in two spines; antennæ and feet are free at the extremity. It rests for a short time under the epidermis of the leaf in a sort of cradle. The insect is very common, but of no importance to the planter. Far different is it with an allied species, the *Elachista coffeella*, G. M., the larva of which is the greatest enemy of the coffee-tree in the West Indies. This latter is of silvery white colour.

22. *Anthomyza? coffeæ.**—This is an inconspicuous grey fly, measuring hardly $1\frac{1}{2}'''$ across the wings, the larva of which mines the coffee leaves in the same manner as that of the preceding species, but much less extensively. It is found more particularly during the dry weather, but is not numerous. The larva undergoes its transformation in a minute, flat, oval cocoon (resembling a seed) under the epidermis of the leaf.

23. *Phymatea punctata.*—This is the large, well-known, beautiful locust with the scarlet abdomen, yellow and bronze above, which seems to attack all agricultural produce that comes in its way. It does not habitually attack the coffee-tree,

---

* Not *A. coffeifolia* as printed in Motch. *Et. Ent.* Nor is the larva parasitic upon that of the *Gracilaria*, as M. de Motch. suggests, never being found in the same burrows, but generally upon separate leaves. Perhaps belonging to *Agromyza*.

but does so occasionally; and I speak from experience when I state that its ravages are very annoying. A swarm of them settled upon a field of one year old coffee, and gnawed the bark off the stems. The consequence was that the growth of the tree was checked in the upper part, and that a multitude of unsightly shoots were thrown out by the lower; eventually the top broke off, or was cut off, and the tree remained disfigured for the rest of its existence. There were at least fifteen per cent. of the trees thus injured. I remember seeing a coco-nut plantation at Negombo infested with these locusts, the enormous leaves of the trees bending under their weight and presenting mere skeletons—everything but the ribs having been devoured. A great many of the locusts had dropped off upon the Illook-grass (*Sachch. Kœnigii*, Retz.) which grew beneath, but they would not touch this,—in fact, I have never seen them eat any but cultivated plants or trees. At Tangalle I have known them to destroy tobacco plantations; and a couple of years ago, I was addressed by the Government agent, Kandy, with reference to the destruction the grain crops of the natives in Matelle were then suffering from these locusts. Fortunately this seems the only species of locust that does any real injury in Ceylon, and this injury is in importance not to be compared with that done by other species in other countries. (See "Kirby and Spence's Introd. to Ent." for details on this subject.) The larvæ and pupæ are equally destructive as the perfect insects.

24. *Ancylonycha spec?* (White Grub).—Under the name of "white grub" the larvæ of various Melolonthidæ do much harm to coffee-plantations, young and old, by eating the roots of the trees. These insects are the cockchafers of this country, and their injuries are of the same nature as those of their representatives at home. Mr J. L. Gordon, of Rambodde, kindly sent me a bottle full of these grubs, for examination. They were 1¼ inch long and ½ inch thick, whitish, thinly covered with red hair, mandibles strong, legs four-jointed, second and third joint soldered together, antennæ five-jointed. As the larvæ of the cockchafer family remain for years in that imperfect state, it is difficult to rear them. I took the larvæ sent

---

* Probably *A. Reynaudii*, Blanch; perhaps *A. mucida*, Schœn.

me for that of a species of Ancylonycha, which, in its perfect state, is very common about coffee estates during the dry weather; but there are undoubtedly other species, the larvæ of which feed with that of the Ancylonycha. Mr Gordon mentioned that he sometimes found larvæ three times as big as those he sent me. These belonged in all probability to the *Leucopholis pinguis*, the large cockchafer, which flies about the pattenas on fine evenings during the dry weather. But I feel certain that cases in which it feeds upon coffee-roots are exceptional, as I have very commonly seen it emerge from the ground on the pattenas; from which circumstance I conclude that it generally feeds upon the roots of the pattena grasses (*Andropogon*, *Anthistiria*, *&c.*) There are many representatives, large and small, of the cockchafer family in this country, but they appear to do no damage in the perfect state.

With regard to the ravages of the white grub, Mr Gordon writes: "They are in my experience by far the greatest enemy of the coffee-tree we have to contend against, as I never knew a single tree to recover after their attack. The damage done here, during the last two years, has been very great—between eight and ten thousand trees of fine old coffee have been destroyed." Fortunately such extensive injuries are exceptional cases. Mr Gordon used to dig up the soil at the foot of the trees, and take out such grubs as he could find.

25. *Arhines? destructor.*—This is a beautiful green weevil; $2\frac{1}{2}'''$ long and $1'''$ broad, oval, narrowed in front, covered all over with closely set but isolated gold green scales, winged. The head is rather short and blunt; antennæ apical, elbowed at the middle, the part beyond the middle being composed of eleven joints, forming a club towards the end, the third joint from the tip being the thickest; they are brown, hairy beyond the middle; the thorax is plump, subconical; the anterior legs are the longest, the second pair the shortest, the tibiæ and tarsi of all are hairy, the tarsi with hairy brushes underneath, especially thick at the third joint which is deeply two-lobed; the tibiæ of the second pair are long, serrated inside, curved, and two-hooked at the apex. The insect varies considerably in size and colour.

This pretty beetle is common during the dry weather, but I have never found it do any injury to the coffee. Mr James Rose, of Maturatte, who first directed my attention to it, writes to me: "The mischief they do to the coffee is really frightful, and if they were as plentiful as the bug, they would be our worst enemies. Five or six acres were completely covered with them, and they consumed almost every leaf. Year after year they appeared upon the same place. This year they appreared upon a neighbouring estate in great force, and ran over at least forty acres. The same thing occurred on three other estates." Mr Rose conveys a pretty picture to the mind of the entomologist by stating, that in May, when these insects disappear, the logs and rocks may be seen strewed with their bright green elytra.

The family of the weevils is one of the most extensive amongst the beetles, and many of its members, both here and in Europe, do much injury to agricultural produce. I have seen nearly the whole sweet potato (*Batatas edulis*) crop of the Negombo district destroyed by one of them, the *Cylas turcipennis*. The common rice-weevil, *Sitophilus oryzæ*, is another instance; and one of the coco-nut destroyers of the low country belongs also to this family, the *Sphænophorus planipennis*.

26. *Acarus coffeæ.*—This is a very minute mite, hardly perceptible to the naked eye, which feeds upon the coffee-leaves nearly all the year round, but more commonly from November to April, giving them a brownish sun-burnt appearance. The damage it does is not great in the aggregate, but individual trees certainly suffer from it. It is closely allied to the "red spider" of the hot-houses in Europe—oval, naked, light red, abdomen darker, four rows of hair along the back, legs hairy. It feeds on the upper side of the leaves, where, amongst the live insects, empty skins and minute red globules are found in plenty. These globules are fixed by a style to the leaf, and are the young in the first stage of existence. The style is the mouth, but the rest of the body is a perfect globule without any appendages whatever. These latter, however, gradually break forth; and when the animalcule is furnished with all it requires, it lets go its hold.

27. *Golunda Ellioti* (Coffee-Rat).—This well-known animal

does not habitually reside on coffee-estates, but comes apparently, when its food fails, from the jungle to the neighbouring estates to supply its wants there. Hence estates with much surrounding jungle are more liable to be infested than others, in the same way as the fields adjoining the jungle suffer more than the more remote ones.

There is a plant which forms a common underwood from six to twelve feet high in the upper jungle—the "Nilloo" of the natives (a species of *Strobilanthus*)—of which it is said that it blossoms every seven years and then dies, whereby the rats are deprived of their accustomed food, and induced or compelled to issue forth on to the estates. This is a popular story, but it is not clear to me, and I have no confidence in it. That the Nilloo blossoms and dies off every seven years, and that the rats feed upon some part of it, I will not dispute. But the Nilloo is not all of the same age, and consequently some will die every year. Besides, the story of the rats coming every seven years is not at all borne out by my experience. We had them here in 1858 and in 1860, and again in 1861. However, when they do come, they are sometimes in very great numbers, and their devastations are very serious. With their long sharp incisors they bite off the smaller and younger branches of the trees, beautifully, regularly, and smooth, and generally 1′ or so from the stem, so as to allow them to rest upon the stump whilst they are gnawing it through. Should the plants be quite young, just taken from the nursery, they bite them right off a few inches from the ground. Their object in doing this is, no doubt, first to get, like other rodentia, at the bark, which they do not appear to devour entirely, but simply to masticate for the sake of the juice,—but probably they act in this respect in accordance with the state of their appetite; and, secondly, to get the leaves for their nests. These latter are commonly found in hollow trees, whither they also drag the bitten-off branches. They seldom appear to eat the berries. They are destroyed either by poison or by traps, in which latter enormous numbers are said to have been caught. There is hardly an estate that does not now and then receive a visit from them.

A small squirrel (probably the *Sciurus Layardi*, Blyth) i commonly found about coffee-estates. This does what the rat apparently does not—eat the berries, which being indigestible, with the exception of the outside pulp, are afterwards dropped and found upon logs and on the ground, in the shape of parchment coffee. Jackals and monkeys occasionally do the same, and a deer will now and then come from the forest and nibble the tops of the young trees ; but these are not serious injuries. By far more so are those arising from buffalo trespass.

This concludes my observations on the enemies of the coffee-tree. However, I must add a few words on the insects commonly found on coffee-estates, without being injurious, and the cause of their presence there.

Most conspicuous amongst these are the black stag-beetle (two spec. Lucanus), the bright green carpenter-beetle (five spec. Campsosternus), and the white and black carpenter-beetle (two spec. Alaus). These insects live, during the imperfect stages of their existence, in the rotting logs which lie about amongst the coffee. The large white, fleshy grubs, with brown heads, are the larvæ of the stag-beetle ; the long, cylindrical, sluggish brown worm, is that of the Campsosternus ; and the larva of the Alaus is black, rather depressed, active, and pugnacious. On attaining the perfect state these insects come forth, and, of course, are seen upon the coffee, where the stag-beetle will now and then attack a cluster of berries. The Campsosterni feed upon honey-dew and Acari, and occasionally devour perhaps a bug. From this reason they are exclusively found upon coffee-trees, whereas the Lucani and Alaus fly about and are met with elsewhere. The smaller kinds of white grubs found in the rotting logs are the larvæ of the flat, black beetles found with them (three or four spec. Passalus). These larvæ have only two pairs of well-developed legs, are harmless, and must not be confounded with the " white grub," the larvæ of cockchafers. About December, a grey weevil (*Astycus* spec.) is found upon the trees, and the blossoms, which come forth some months later, are frequented by various insects allied to the English rose-beetle (*Clinteria, Tæniodera, Popilia, Singhala*), but none of these appear to do much harm.

A bugged tree presents, on a fine sunny day, generally a very animated, and, to the entomologist, highly interesting picture—a perfect microcosm—a small world of its own.

Besides some of the insects just alluded to, and perhaps some gaudily-coloured butterfly, numerous Hymenoptera (especially Formicidæ, Sphegidæ, and Ichneumonidæ), several Phryganidæ and Diptera resort to it, and a bright green Mantis pounces constantly out from behind the leaves upon the unwary flies. I believe that twenty-five different species of insects might easily be gathered off a single coffee-tree on such an occasion. None of these insects do any injury to the tree, nor to the bug either, most of them resorting to the tree for the sake of the honey-dew, and some in order to prey upon the smaller insects which are attracted by this sweet substance. Amongst the Phryganidæ (caddice-flies), is very common the *Chimarrha auriceps*, Hag., which is red, with black wings, feelers, and eyes. I mention this insect particularly, because Westwood (Introduction to Entomology, vol. ii. p. 69) says, that the caddice-flies in their perfect state take no nourishment. This, however, is not so in the species which frequent the coffee-tree.

The Mantis of the coffee-tree (*M. tricolor*, N.) is green, lower wings reddish, with large blackish spot at posterior margin. The female is 1″ long, expanse of wings 1½″; the male considerably smaller. The young larvæ are black. The eggs are deposited upon coffee-leaves in cocoon-like masses of ⅝″ in length, not including a long point to which the mass is drawn out on either end, and which would make it upwards of 1″ long. These nests are very delicate cake-like structures, much less coarse and substantial than those of the larger species. Amongst the flies, there is, about December, a fine large Tephritis with green eyes and variegated wings. I have not observed its larva to reside in any part of the coffee-tree.

Further Remarks on Lightning Figures, &c. By CHARLES TOMLINSON, Lecturer on Science, King's College School, London. (Plate I.)

In a paper read before the Physical Section of the British Association at Manchester in September last, and inserted in the October number of this Journal (vol. xiv. p. 254), I have attempted to show that the tree-like impressions which are sometimes found on the bodies of men and animals that have been struck by lightning, are produced, not by any photo-electric action, as has been supposed, but by the figures which the lightning itself assumes in striking the earth. In that paper the method of producing these figures by the discharge of a Leyden jar was given, and all that was wanted to complete the theory was a similar figure due to the action of the lightning itself. Such a case was observed by Charles Pooley, Esquire of Weston-super-Mare, during a thunder-storm which passed over Oakley Park, near Cirencester in July 1857. An ash-tree was struck by lightning, and on the inner surface of the torn-off bark some ramified lightning figures were found. An account of the accident, together with a drawing of the tree, and specimens of the bark, were forwarded by Mr Pooley to Professor Faraday, who has kindly placed them at my disposal on the present occasion.

Mr Pooley says: "The storm came from the north-west, and was accompanied with heavy rain. The first force of the electric discharge was expended on a branch north-west of the tree, which it barked and shivered to pieces. The fluid then passed through the fork of the tree without injuring that immediate part, but descending the south-west side, cut a clear line about 1½ inch in width out of the bark, and loosened the bark to the extent of 1½ foot on each side of it. The seam gradually widened as it reached the knotty roots. The point of interest, however, is in the circumstance, that on the inner surface of the fragment of the bark, which I picked up within half an hour after the accident, is to be found the actual impress of the passage of the electric flash.

"On it may be seen the tongue-like coruscations by which the force of the electric fluid expended itself, and which are gouged out, roughened, and slightly charred at the edges.

"Several other trees were struck by lightning on that and the succeeding days, all of which I visited in the neighbourhood, but on none of them could I find a trace resembling this, nor have I ever seen a similar instance, where the likeness of the flash is preserved. In the longer piece it is the more distinct. I have placed a bit of pink paper to denote the upper end, from which the progress of the coruscation can be easily traced."

The letter, of which the above is an extract, is dated 1st February 1858. On examining the specimens of bark at the Royal Institution in November 1861, or three years and a half after the accident, they had become somewhat warped, and the inner surface had assumed a brick-red colour in drying. The track of the lightning was not very distinct, blending as it did with the general colour of the surface; while the contraction in drying and the alteration in colour had doubtless obliterated some of the lines. I can therefore only represent it as it appeared to me in the following drawing; but Mr Pooley, in a letter to me, dated November 23, 1861, says, "The inside lining of the bark was not brick-red when I found it, but almost white, yellowish white; and the lightning coruscations were as vividly distinct as if they had been burnt in by a red-hot iron, the margins of each stroke being somewhat less charred than the central line of each stroke. The brickish red colour it has assumed by drying and exposure to the air."

Such is the instructive and interesting case furnished by Mr Pooley. That it does not often occur may arise from two circumstances: *First*, That a scientific witness is seldom at hand to give evidence when such a case arises; and, *secondly*, the extreme heat and mechanical violence of the lightning stroke may obliterate these ramified marks after they have been formed. And, even when spared by the lightning, the majority of observers would probably not think them worthy of notice and record. We do, however, occasionally find some slight notice of these figures in an almost unconscious expression of the reporter. Thus, in a case given in the twenty-third volume of the "Comptes Rendus," a house in the Island of Zante was struck by lightning, and a young man killed while in bed. In the *post-mortem* examination the passage of the lightning was traced along the body, from a wound under the right foot of more than an inch in length, along the leg and thigh, up the back to the neck. The track was of a dark brown or black colour, and the skin all about it presented *ramified* scarifications. The hair was burnt off the body, including the eyelashes, eyebrows, and hair of the head. On the middle of the right shoulder were six circular marks of a flesh colour, and well defined on the blackened skin. These circles were of different sizes, and corresponded with those of six gold pieces which the young man wore on his right side, in a belt that passed round his body, at the time of the accident. It is supposed that an ascending stroke of lightning entered the right foot, passed up the body to the coins, from them to the shoulder, *carrying and fixing an impression of them* (but how it is difficult to explain), and then bounded off to the window, by which the fluid disappeared. The room smelt strongly of burning sulphur and bitumen, which was accounted for by the charred flesh and clothes.

A case where similar deep wounds were produced is reported by M. Goyon in the "Comptes Rendus," vol. xliv. The brig *La Felicité, en route* for Algiers, was struck by lightning near the Cape de Garde, on the 16th December 1856. Six men were thrown down and fearfully wounded, and in one case the wounds were blackened as if by charcoal. The men were landed, and taken into the hospital, and the medical officer, reporting on the case of one of them on the 12th of January, says, "Les bords de la plaie étaient surmontés par des croûtes recouvrant de gros boutons charnus. Son aspect demonstrait du reste que non seulement le derme mais encore une épaisse couche de tissu cellulaire, avaient été compris dans l'escarre." This was the worst case, on account of the man resting with his leg against the mast at the time it was struck. Another man was struck in the mouth; and during the next few days, the whole of its mucous membrane, including that of the tongue, came away in shreds. The teeth also were blackened, as if by charcoal, and loosened.

Cases of this kind may be multiplied to almost any extent; but in nearly every case, when faithfully reported, there is something that cannot well be explained by known electrical laws. But the enormous scale on which Nature works may perhaps account for effects which our puny efforts fail to imitate. The duration of the electric discharge is so excessively short, that it is difficult to understand how its heat can have time to act in producing such extensive effects of fusion, carbonisation, and mechanical expansion. The charring of the wood of a tree struck by lightning is sometimes very decided, as in the case recorded by M. Boussingault in the "Comptes Rendus," vol. xxii., where the lightning struck a pear-tree in a field by the side of the road from Wörth to Reichshoffen, 5th May 1846, at 2 A.M. The trunk was 3 metres high, partly hollow, and the diameter near the ground 50 centimetres. The leaves and bark were not injured by the lightning, with the exception of some centimetres square of epidermis near the point where the trunk divided into two great limbs. There the tree was completely split into two nearly equal parts, the lightning following the inner wall of the trunk. At 1 m. 50 from the bifurcation, the wood was impressed with a fuliginous matter, similar to the smoky trace of a candle on a cold surface. Lower down the black matter was more decided, but quite superficial. Still lower, at a distance of 50 centimetres from the soil, the wood had the appearance of the *charbon roux* used in making gunpowder. At 20 centimetres above the soil the carbonisation was complete, and a portion of the wood had been consumed. The fire was discovered at 4 A.M., and the people said that the smell of sulphur was insupportable. M. Boussingault compares the odour to that produced by the distillation of vinegar from wood.*

Cases are recorded in which trees in leaf have been parched by atmospheric electricity passing over them. M. Peltier (*Des Trombes*, Paris, 1840) records a case of this kind which occurred on the 18th June 1839 in the neighbourhood of Chatenay, in the department of Seine et Oise, during a thunderstorm, or rather two storms, which were raging at different elevations at the same moment, and repelling each other. The lower storm communicating with the earth, its thunder ceased; but a powerful attraction was experienced on the earth's surface, all light bodies being drawn upwards in the form of an inverted cone. Trees which encountered the storm had their leaves parched and made brown by the lightning, while the side away from the storm preserved all its freshness and verdure. Some of the trees were split into laths, and large boughs were divided into fibres like those of a worn-out broom. Ears of corn were also parched on the side of the storm, and the leaves of vines trailed in front of a house were also parched up.

---

* Scientific observers have compared the odour arising from a lightning stroke in a building to that of phosphorus, nitrous acid, ozone, &c. There is a case recorded by M. Desormery in which the odour was *alliaceous* rather than sulphurous. The smell of sulphur is a popular expression for almost every case of accidental combustion accompanied by smoke and odour. It is stated, however, that sulphur has actually been found on the surface of gilt metal objects that had been blackened by lightning. Thus, on Sunday the 14th of June 1846, the parish church of *St Thibaud-de-Conz*, three leagues from Chambery,

When trees in full leaf have a brown and withered appearance, it is common to refer the effect to lightning. Such, however, is not always the case. In September 1861, my attention was directed to some trees in General Buckley's park, close to the road leading from Salisbury to Downton, which it was said had been struck by lightning during the preceding spring. Three trees had been attacked; the centre tree had its foliage parched and embrowned, and half of each tree on the side of this central one was in a similar condition, the remaining halves preserving their freshness and verdure. On examining these trees, I was led, from the absence of signs of mechanical violence, to suspect that lightning had not produced the charred appearance. Accordingly, I wrote to General

was struck by lightning. The church was filled with a thick smoke, the smell of which was compared to that of gunpowder. The chandelier and various gilt ornaments were struck and blackened, and next day M. Bonjean scraped off some of the powder, and had no difficulty in detecting sulphur in it. He thinks that sulphide of hydrogen rather than sulphurous acid accompanies the lightning, and assists in blackening the metal. So completely does the idea of the sulphur odour possess the popular mind in connection with lightning, that in a case brought before the Academy of Sciences at Paris of a sailor struck by lightning, on recovering his consciousness he became sea-sick, and the vomit smelt strongly of sulphur !

Buckley's agent, to ask for his explanation of the matter, and received the following satisfactory reply, dated October 5th, 1861:—

"Sir,—In reply to your note of the 1st inst., I beg to state that I do not believe the trees situated in General Buckley's estate were struck by lightning at all. I have been in the habit of making a large quantity of gas-lime compost at the foot of the trees, and am inclined to believe that the vapour from this mixture caused the leaves to shrivel and die off. They came out a second time, but as the process was repeated, they were again withered. There is no mark on the trunks or branches of the trees.—Your obedient servant,

"W. Moore."

It should be stated that these trees, being separated from the road by the park palings, the preparation of the compost would not have attracted much attention, while the withered trees themselves were prominent and very curious objects.

The action of lightning on trees has led to statements which Science keeps in view, while she waits for their verification. It was once supposed that the lightning struck some trees in preference to others, but it has been repeatedly proved that the favoured trees have been often struck. Foresters are of opinion that those trees, even of the same species, which have the most abundant foliage are more liable to be struck than those which are more scantily clothed. Nor are the tallest trees always the mark for the thunderbolt. M. Desormery, while travelling in Auvergne, was struck down by a discharge which at once drove a hole through a cottage wall, magnetised an iron vessel resting against it on the inside so that nails flew up to it, killed a child, and struck the shorter of two poplar trees, one of the branches of which was divided into a bundle of laths of so remarkable a regularity as to resemble a product of man's industry. (*Comptes Rendus*, tome xxviii.) There are many other cases in which trees of comparatively low elevation have been struck, while tall ones near at hand have been spared. In 1856, M. Dureau de la Malle informed the Academy of Sciences at Paris, that during the preceding seven years three bignonias in the plantations surrounding his house had been struck by lightning, although these shrubs were topped on all sides by larches, pines, acacias, and plane trees.

In the "Gardener's Chronicle," a few months ago, it was stated that a common oak-tree in Scotland had been struck by lightning some years before; and on recovering from its injury, it was remarked in the following spring that the leaves were *variegated*, and it is said that they have continued to be so every year since. A verification of this statement would be desirable.

On the Aqueous Origin of Granite. By ALEXANDER BRYSON, F.R.S.E.*

For many years after Dr William Smith, the father of English geology, had published his "Tabular View of the British Strata," in 1790, geology was studied only in the direction of palæontology. Physical, chemical, and dynamical geology were left by the great masters of the science almost unregarded since the early years of the Royal Society of Edinburgh, when its meetings were made brilliant by discussions on the theory of the earth, the formation of granite, trap, and porphyry, by Hutton, Hall, and others. When Dr Smith announced his great discovery, that fossils prove the relative ages of formations, geologists were naturally tempted to leave their former fields of inquiry as barren, and enter with enthusiasm on the study of palæontology, as promising richer results; thus, for nearly half a century they were content to receive the speculations of Hutton and the experiments of Hall as demonstrative of the plutonic origin of the primary rocks.

In attempting to prove the aqueous origin of granite, I will not adduce any views trenching on the domain of the theologians who assailed Hutton and his followers, believing as I do that geology has no necessary connection with cosmogony —metamorphosis, not morphism, being its proper study.

---

* Read before the Royal Society of Edinburgh, April 29, 1861.

Speculations on the origin of granite are nearly coeval with the foundation of this Society. In the first volume of its Transactions, Hutton has stated, in his celebrated paper on the Theory of the Earth, " That the nature of granite, as a part of the structure of the earth, is too intricate a subject to be here considered, where we only seek to prove the fusion of a substance from the evident marks which are to be observed in a body." " We shall therefore only now consider one particular species of granite; and if this shall appear to have been in a fluid state of fusion, we may be allowed to extend this property to all the kind. The species now to be examined comes from the north country, about four or five miles west from Portsoy, on the road to Huntly. I have not been upon the spot, but am informed that this rock is immediately connected or continous with the common granite of the country. This, indeed, appears in the specimens which I have got, for in some of these there is to be perceived a gradation from the regular to the irregular sort. This rock may indeed be considered, in some respects, as a porphyry ; for it has an evident ground, which is felspar in its sparry state ; and it is in one view distinctly maculated with quartz, which is transparent, but somewhat dark coloured. Considered as a porphyry, this specimen is no less singular than as a granite. For instead of a siliceous ground maculated with rhombic felspar, which is the common state of porphyry, the ground is uniformly crystallised, or a homogenous regular felspar maculated with the transparent siliceous substance. But as, besides the felspar and quartz, which are the constituent parts of the stone, there is also mica, in some places it may with propriety be termed a granite." Hutton further states, " that it is evident from the inspection of this fossil that the sparry and siliceous substances had been mixed together in a fluid state, and that the crystallisation of the sparry substance, which is rhombic, had determined the regular structure of the quartz, at least in some directions."

The mineral here alluded to by Hutton is the well-known graphic granite of Portsoy. Where he found the evidences of its fluid fusion I have not been able to discover; that it was in aqueous solution, I shall attempt in the sequel to show. This was a very narrow basis on which Hutton reared so large a generalisation that the granites were of igneous origin, but Sir James Hall came to his aid, and most ingeniously endeavoured to strengthen Hutton's position. On this point Sir James Hall remarks, "To a theory, however, which embraces so great a variety of objects, some difficulties must be expected to occur, and this is the more likely to happen that, though the agents employed in it be such as we are well acquainted with, yet they are introduced as acting in circumstances very different from those in which we usually see them act. Of these difficulties the most considerable appeared to him to be the following: In granite, which contains quartz and felspar, it frequently occurs that felspar is seen with the form of its crystals distinctly defined, whilst the quartz is a confused and irregular mass, being almost universally moulded upon the crystals of felspar. Now, were it true that all granite is formed by fusion, the very contrary, it would seem, ought always to take place, as felspar is very easily melted, and quartz resists the greatest efforts of heat that have hitherto been applied to it. This difficulty is obviated thus. It is well known that when quartz and felspar are pounded and mixed together, the mixture may without difficulty be melted and run into a kind of glass, the felspar serving as a flux to the quartz. The same fact may be stated in another way, by considering the felspar when melted as a fluid in which, as in a menstruum, the quartz is dissolved; and in this view we may expect, by analogy, that phenomena similar to those of the solution of salt in water should take place.

"Now it is certain that when excessive cold is applied to salt water, the water is frozen to the exclusion of the salt, the ice obtained yielding fresh water when melted, and the salt, when the experiment is pushed to the utmost, separating from it in the form of sand. Why should not the same thing happen in the solution of quartz in liquid felspar, when the mass is allowed to cool below the point of congelation of the menstruum?

"The felspar may crystallise separately from the quartz, as we have seen pure ice formed separately from the salt, in both cases the *congelation* of the solvent being simultaneous to that of the dissolved substance. Hence the crystals may mutually interfere with each other's forms, and we may naturally expect to see quartz moulded on crystals of felspar, or the reverse.

"In answer to an objection which might be urged against this reasoning, viz., that the result of the fusion of granite is a glass in which no crystallisation can be seen, an accidental experiment was produced, which happened at one of the Leith glass-houses a few weeks previous to the reading of this paper. A quantity of common green glass having been allowed in a great mass to cool gradually and very slowly, it was found to have lost all the properties of glass, being opaque, white, very hard and refractory, and wholly composed of a set of crystals which shot into some cavities in a determinal form.

"The same principle seems to point out the theory of all kinds of granite, and shows their connection with one another and with all the other unstratified bodies. If quartz, felspar, schorl, mica, garnet, &c., happen to be melted together, the most fusible substance of them all may be considered as the menstruum in which all the rest are dissolved, and we may suppose that these various dissolved substances may differ amongst themselves in their properties of solution, as salts differ from one another, so that some of them may be more soluble in the menstruum when very much heated than when it is comparatively cold, and others may be as soluble in it when little warmer than its point of congelation as when raised to a much higher temperature." Hall submitted powdered limestone and calc spar to heat and pressure; at fifty atmospheres he obtained a compact limestone, and at eighty-six a crystalline marble. These experiments and generalisations date from the beginning of this century. We can scarcely now appreciate their full intrinsic worth; but how our fathers estimated them is evident, that this experiment of Hall was made the ground of a flag of truce to convey the news of it to the French Academy—a fine instance of the cosmopolitan nature of science.

To these views of Hutton and Hall, Dr Murray, in his "Comparative View of the Huttonian and Neptunian Systems of Geology," thus replies: "The structure and appearances of granite as a fossil have been brought forward by Dr Hutton as favourable to his hypothesis. There can be no doubt that this rock has at one time been fluid. Its constituent parts, particularly the felspar, and sometimes the quartz, are crystallised, and it not unfrequently contains other crystallised fossils. This fluidity, from which it has been consolidated, Dr Hutton conceives is proved to have been that of fusion, from the parts of the granite impressing each other. The species of granite termed graphic is stated particularly as establishing this deduction. In it the felspar is crystallised in its usual rhomboidal form, and these crystals impress the quartz, put it aside as it were, and give it its particular situation along the side of the rhomboidal felspar." "Hence," says Hutton, "this granite is not a congeries of parts, which, after being separately formed, were somehow brought together and agglutinated; but it is certain that the quartz at least was fluid when it was moulded on the felspar." And "this fluidity was not the effect of solution in a menstruum, for in that case one kind of crystal ought not to impress another, but each of them should have its own peculiar shape."*

Murray further replies, "It has already been shown how simultaneous consolidation may take place from solution, and the structure of granite can from this circumstance furnish no argument against its aqueous origin. But it affords the clearest demonstration that it has not been formed by fusion. Felspar is a substance incomparably more fusible than quartz, the first varying from 120 to 150, the other being 4043 of Wedgewood's scale.

"It is a proposition, therefore, self-evident and undeniable, that in the same mass quartz could not be fluid when felspar was solid; and therefore, since in this graphic granite the quartz is moulded on the crystallised felspar (and in the greater number of granites the felspar is crystallised while the quartz is not), the fluidity whence both have been consolidated cannot have been fusion from heat." "The force of this argument from the crystallisation of felspar in granite may be estimated by a very simple consideration. If the appearance of this fossil had been the reverse of what it is; if the quartz had crystallised and shot through the felspar, would it not have been brought forward as a proof, or at least as a strong presumption, that both had consolidated from fusion? Yet the fact, as it is, is still stronger in proving that such could not have been their origin, since it is an evident impossibility that in two substances fused together, the most fusible should concrete before the one that was least fusible, or required the greatest heat to keep it fluid. Had the former even been congealed by some cause, of which we can form no conception, the high temperature keeping the other fluid, must have again immediately fused it. . . . . Besides the crystallisation of felspar in granite, regular crystals of it are not unfrequently found embedded in quartz, a proof, which cannot be eluded, that the felspar has become solid while the quartz remained fluid, contrary to what must have happened from the known fusibilities of those substances if they had consolidated from fusion."

---

* Illustrations of the Huttonian Theory by Professor Playfair, p. 86.

These admirable views of Murray found little favour with the geologists of the time, who were glad to leave a field where each party sought to support their theories rather than seek for truth; and it was not until Lonchamp, in 1826, showed veins of iron pyrites in the hot springs of Chaudesaignes, that geologists turned again their attention to the study of chemical and physical geology. The first important researches which had for their object to show the part water might have in the formation of minerals and rocks is due to Becquerel, Fuchs, Silliman, Dana, and Bischoff. The first had succeeded in obtaining, by a humid method, the conditions and appearances which galena and sulphide of antimony present in nature. Since the labours of these eminent chemists, Delesse has concluded, from a chemical analysis of the eruptive rocks at the point of junction with the other strata, that the changes effected have been more through the aqueous vapour charged with different salts or acids than by heat.

It had many years ago suggested itself to the sagacious mind of Davy, that the occurrence of fluids in the cavities of crystals seemed to point to an aqueous origin under pressure.

Sir David Brewster has also devoted much time to those fluid cavities in minerals, and has enriched the Transactions of the Royal Society of Edinburgh by his labours on this subject.

Mr Sivwright, and the late William Nicol, to whom I am mainly indebted for my collection of fluid cavities, both added much to our knowledge of the subject. The bearing of these observations on the aqueous origin of granite will appear in the sequel of this paper.

In 1856 I had the pleasure of showing to Mr Sorby my extensive collection of crystals containing fluid cavities, and stated my views on the subject of their formation. He has published an elaborate paper on the subject, well worthy the attention of the physical geologist, though I cannot concur in his generalisations.

During ten years' experimental investigation into the structure of rocks, relative to their formation (more particularly granite), my attention was specially directed to the microscopic structure of the various pitch-stone veins abounding in Arran; I was much struck with the similarity of their structure, and the marked difference they exhibit when compared with sections of granite and its various mineral constituents. On extending my observations to obsidian, Marekanite, a volcanic glass from Lake Marekan in Kamtschatka, and also to the well-known glassy obsidian of Bohemia, I found they all exhibited a structure analogous to the pitch-stones of Arran, and also all glass slags where the heat has been long continued, combined with slow cooling.

This structure, peculiar to igneous formed substances, is generally radiated in a stellate form, and although usually microscopic, many slags often exhibit it on a large scale. It is so marked a character that no one whose eye is tutored to microscopic observation can fail to recognise at once a mineral substance of plutonic origin.

In granite, on the other hand, the characteristic microscopic structure is as persistent as in pitch-stone obsidian, &c., but totally different. In the many experiments I have made I have never succeeded in obtaining an instance of stellate structure; while the constant occurrence of cavities containing fluids have convinced me that, if pitch-stone and glass are types of igneous formed substances, granite must be of aqueous origin.

In the fluid cavities so abundant in topaz, Cairngorm, beryl, tourmaline, felspar, all constituents of granite, the same general appearance prevails. The cavities are seldom entirely filled with fluid, an air-bubble occupying more or less of the cavity,

After many hundred experiments on such cavities, I found that, when exposed to a temperature of 94° Fahr. (the mean heat of the experiments as detailed in my note-book), the bubble disappeared, the fluid entirely filling the cavity; at the mean temperature of 84° the bubble reappeared. I was thus led to infer that those cavities could not have been filled at a temperature above 84°, and certainly not above 94° Fahr.

As another proof that these cavities could not have been filled when the temperature of the surrounding rock was higher than the temperature above indicated, I beg to call attention to the fact, that the bubble of air occupied always a much smaller portion of the cavity than the fluid,—a condition which could not obtain if, as other writers on this subject hold, the fluids were enclosed under intense heat and pressure. Fig. 1 exhibits the stellate appearance found in various glass slags; fig. 2 shows the microscopic view of a section of the pitch-stone from Arran; and fig. 3 represents the fluid cavities in the topaz and quartz of granite.

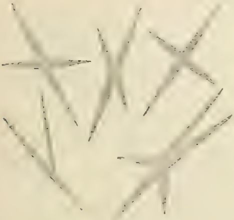


Fig. 1.

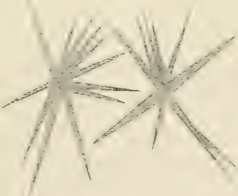


Fig. 2.

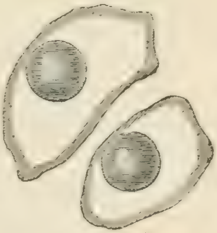


Fig. 3.

For the purpose of determining with accuracy the temperatures at which the bubble vanished and reappeared, I constructed an apparatus represented in fig. 4.

It consists of a microscope with a hollow tin or copper stage A, having a tube in the centre to admit light from the reflector. At one side, and inserted into the stage, is a small tin retort with a stopper B; at the other side a tube is inserted, and is attached to a reservoir of water C, from which the hollow stage and retort are filled. On applying heat to the retort by means of a spirit lamp D, any required temperature under the boiling point of water may be obtained in the stage and retort.

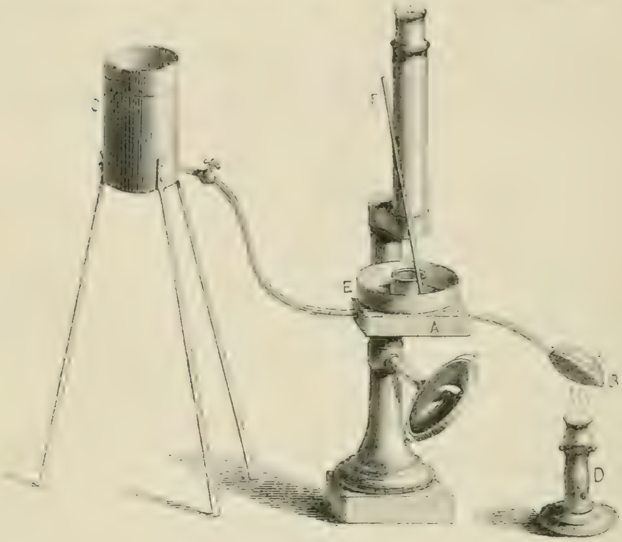


Fig. 4.

Above the stage is placed an iron saucer E, in the centre of which an iron tube is rivetted, through which the light is admitted. This vessel is filled with mercury, and in it is placed an upright thermometer F, with the bulb shielded with cork or any other good non-conductor; by this means it indicates the actual temperature of the mercury bath. The mineral containing the cavities is cemented with Canada balsam to a plate of glass 3 × 1 inch, and is floated on the surface of the mercury, so that the glass and mercury are in absolute contact. When the temperature is raised until the bubble nearly disappears (which is seen by its contraction), the spirit-lamp is withdrawn, and the vanishing point carefully watched and the temperature noted. The stopper of the retort is then withdrawn, and the stopcock of the reservoir of water opened, so that the temperature of the stage and mercury bath is soon reduced, and the ebullition or reappearance of the bubble takes place when the temperature is again recorded.

By this method I obtained very accurate results, as they were always consistent when the same cavity was observed.

When small chips of minerals are to be observed, and where the difficulty of grinding and polishing two parallel surfaces is great, it is common to place the small objects in a cell covered with thin glass, and fill the cell with a fluid of the same refracting index as the mineral. By this method I found that the porphyry of Dun Dhu in Arran (which most geologists describe as of igneous origin) was full of cavities contained in the doubly acuminated crystals of quartz for which this remarkable porphyry is distinguished. I also discovered, in the doubly acuminated crystals of quartz found in the saliferous gypsums of India by my friend Dr Andrew Fleming, thousands of fluid cavities, and the quartz impressed with the gypsum; and as no geologist would hold that this formation was of igneous origin, and as the quartz was impressed by the gypsum, if not contemporaneous, must have been subsequent to it; and as the same phenomena were exhibited in the porphyry of Dun Dhu, I am forced to the conclusion that the latter was as much aqueous in its origin as the saliferous gypsum from India.

Another fact here is worthy of record. I possess a specimen of quartz from California; it contains a crystal of iron pyrites, to which is attached a small mass of zinc blende, while over these three is laid a covering of gold. It is clear that as all those metals are fusible at a much lower temperature than the quartz, they must have aggregated during a gelatinous condition of the silica; and further, as the sulphides of the three metals are in chemically combining proportions, any heat which would have fused the quartz would have made an alloy or a slag, in which chemically combining proportions could not occur.

Nor is the question of the gelatinous condition of quartz so difficult, since Professor Graham has shown in his recent researches in dialysis that pure silica can be held in solution in water to the extent of 15 per cent.

Perhaps no finer proofs can be obtained of the quartz of granite having been gelatinous than in those specimens which contain schorl or tourmaline, so frequently found in Aberdeenshire. Fig. 5 is a good example of many such in my collection. and is singularly instructive.

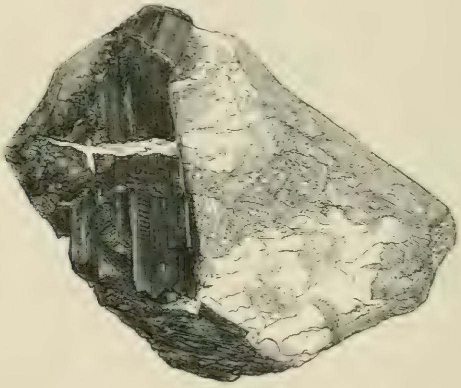


Fig. 5.

It is well known to mineralogists that tourmaline crackles and splits with a small increment of temperature, and therefore could not have been present during a molten condition of the quartz; and that it was crystallised prior to the solidifying of the latter, is proved by the schorl impressing the quartz. Further, from many careful measurements of the peculiar fractures of the tourmaline and its contortions, and also from the amount of quartz which had entered into the fissures of the former, I am led to believe that the quartz, while in the process of crystallization, expanded $\frac{1}{24}$th of its bulk. Such a force appears to me to be amply sufficient to cause all the upheavals and disruptions which other geologists have accounted for by supposing a molten condition of the primary rocks. If this view is correct, and if the highest peak is granite, and we know that the lowest is granite, it follows that, as the highest mountain is only $\frac{1}{571}$ part of the radius of the earth, a thickness of the crust of 168 miles is quite sufficient to yield expansive force to raise the highest peak of the Himalayan range. It may be objected, in regard to the temperature at which it seems the fluids were enclosed, as being too high for the normal temperature of the earth; but it must be recollected that pressure and also solidification from fluid conditions develop heat.

Organic Method in Zoology. By HUGH DOHERTY, M.D.

The gorilla, in its approximation to the "human form divine," has caused uneasiness, perhaps, to many consciences already more or less disturbed by the development theories of the "Origin of Species," which have been revived of late, with somewhat of a plausible appearance of natural truth being contrary to revealed religion. There cannot be a real discrepancy between natural and spiritual truth, although erroneous theories of natural organic laws may hold the mind in thraldom for a time and sow confusion in the consciences of pious men.

The so-called rationalistic theory of the "Origin of Species" nowhere proves the fact of any original metamorphic evolution by "natural selection;" but merely a development of individual organs and faculties by growth, exercise, experience, and education, from which facts it assumes the possibility, and even probability of metamorphic evolution in a genetic or creative sense. The assumption is entirely gratuitous, without the shadow of a demonstration.

If the theory were true, it would only prove that the original germs of animal creation were less perfect in powers of metamorphic evolution than the germs of procreation in the animal kingdom, and that the latter were, in fact, the continuation of the former, in a perpetual renewal of the first creation.

These questions need not be discussed, for nothing is known of the origin of species which deserves the name of a rational theory. Cuvier believed in the distinct creation of each species.

Man is evidently a part of the animal kingdom on our globe,—the highest type in the realm of vertebrata. He is the brain and mind of the collective animal kingdom, distinct from other types of organism, as the brain and nervous system in the human body are distinct from other systems in the individual organism; and as man, having the highest cerebral development, is the highest organism in nature, so other species are inferior in degree, and correspond in rank with the inferior organs and systems of the individual organic unit.

All the higher vertebrata are more or less allied to man in general form and structure; and the monkeys are but little nearer to the human form than many other types of dumb creatures. Anthropoid apes are not less speechless than the common monkeys, nor are these less animal than other brutes in all their instincts and peculiarities. There is no more reason to suppose that man proceeds from apes than that apes proceed from dogs, and these again from lower types of vertebrata. It is mere hypothesis and wild conjecture. Organic method, duly understood, will scatter to the winds unsound hypotheses; but this is yet to be developed as a positive science.

The following outline of such a method may be, and no doubt is, imperfect; but it will serve at least to show the tendency of modern thought on these important questions, and preserve the minds of the unlearned from being disturbed by theories of natural science, which may be multiplied in various ways with an equal show of plausibility.

There is, no doubt, order and method in the universe, and in the plan of creation on our globe; and this plan is manifest in every variety of organism within the limits of investigation by the human mind.

Anatomy and physiology have already made the organs of the body and their special functions known to us in all minuteness, but the laws of organic unity are still a riddle without a satisfactory interpretation. We have not a comprehensive view of plan in the creation, nor a knowledge of the principles of natural organic method, either in the individual organism, or in the different collective units of organic forms, such as the vertebrata, articulata, mollusca, radiata, &c.

Organs, and groups of organs, in the body, have been well described, but series and systems have been hardly noticed. Individuals and congeneric groups of species have been well observed in different classes of the animal and vegetable kingdoms; but series and systems of congeneric groups have been less accurately studied by the eminent zoologists and botanists who have given their names respectively to many contradictory and unsatisfactory methods of systematic classification, and contending theories of the "origin of species."

Cuvier, De Blainville, Macleay, Van Der Hoeven, Owen, and many other eminent zoologists since Linnæus, have published each his own peculiar system of arrangement, based on what he deems some leading features of organic structure; but none of these agree in definite principles of method, or in the application of their views to natural divisions and associations.

Buffon, Geoffroy St Hilaire, and many other men of eminence in natural science, have theorised on the probable development and metamorphic evolution of all known species, including man himself, from a few simple germs of the lowest type and rank in nature. Cuvier and many other noble minds have denied the rationality of such a theory, and maintained the common faith of Christians with regard to the creation, The rules of method in division and classification are still in a chaotic state, even amongst those who are most eminent in science. Some lay stress on number as a key to natural divisions, others follow structural peculiarities without regard to theories of number. One of these views need not exclude the other; but as yet no leading principles of method have been universally recognised.

According to Mr Kirby, "the number *five* assumed by Macleay as a basis of method consecrated in *nature*, ought to yield to the number *seven*, which is consecrated both in *nature* and in *Scripture*." "Metaphysicians," he observes, "enumerate seven principal operations of the mind; musicians seven principal tones; and opticians seven primary colours. In Scripture, the abstract idea of this number is *completeness, fulness, perfection*." He believes that Mr Macleay's *quinaries* may be resolvable into *septenaries* by more elaborate investigations;" but we may here state that the number seven is not the only numerical basis of natural division in organic method.

Richard Owen makes four primary divisions in his classification of mammalia. His distinctions of the *Lyencephalous*, *Lissencephalous*, *Gyrencephalous*, and *Archencephalous* subclasses are, no doubt, known to all your readers, and therefore need no comment here. Many points of interest have been dwelt upon in these cerebral distinctions, but they do not form a complete system of divarication.

In lieu of the brain alone, or in connection with concomitant modifications of structure in other parts of the organism, we may take the whole body as a type of organic unity, and the most obvious natural divisions of the organism as a basis of numerical distinction and methodical grouping. These are the following distinct systems: the *alimentary*, the *vascular*, the *generative*, the *nervous*, the *osseous*, the *muscular*, and the *cutaneous* systems; with the organs of sense which belong to them respectively. In the vascular system, we include air-vessels, blood-vessels, and water-vessels, or the respiratory, the circulatory, and the urinatory series of organs in the body. The rank of each vertebrate mammalian organism may be seen in the cephalic structure, as remarked by Owen, but rank alone is not a sufficient basis of primary divisions in a natural organic method.

Taking this septenary view of the distinct systems, with the additional quinary view of the five senses, we have a natural numerical division of the complex unity exemplified in an individual vertebrate organism; and this principle of natural subdivision in a simple organic unity, suggests the idea of a similar numerical law of subdivision in the parts of a collective organic unity, such as that of the mammalian class of vertebrata. The collective ideal type may differ from the individual type in some minor points, such as those of a *trunk* in the elephant, a *marsupium* in the kangaroo, and other exceptional points of structure in certain species hardly shown, or only rudimentally developed in the highest individual organism, such as that of man; but these details may be embodied in a general formula of method, including all the individual varieties of type and form.

Let us see, then, how this law of order, in organic grouping, as exemplified in the individual organism, may be applied to that collective organism of vertebrata embodied in the class mammalia. Seven natural alliances may easily be placed in parallel with the seven systems of the human body; not, perhaps, with any preconceived idea of analogy or correspondency, but merely as a fact of natural organic subdivision; thus,—

Seven Alliances of Mammalia.

1.	The Quadrumanal alliance,	2.
2.	The Plantigradal alliance,	4.
3.	The Digitigradal alliance,	3.
4.	The Bimanal alliance,	1.
5.	The Equine alliance.	7.
6.	The Ruminant alliance,	6.
7.	The Pachydermal alliance,	5.

These alliances may seem at first imperfect, but a subdivision into orders will make them appear less so. In the Quadrumanal alliance there are the Simial and the Lemural orders; in the Plantigrade, the Ursine and Marsupial orders; in the Digitigrade, the Feline and the Canine orders;—each containing subdivisions to be noticed presently. The Bimanal alliance forms but one order, and this order but one family, and, indeed, but one species; and yet we place it in parallel with the whole nervous system in man, which ranks even higher than the other systems. The brain is the recognised organ of the mind in man, and man is the acknowledged head of the creation.

The Equine alliance, also, forms one order only, or one family. The Ruminant alliance is much more complex, and may be naturally subdivided into a horned order and a hornless. The Pachydermal, properly so called, forms but a single order; but the Rodents are so nearly allied in many leading points of structure with the Pachyderms that we place them together in the same alliance.

This arrangement of the seven alliances forms a dozen orders of mammalia; thus:—

Class Mammalia in parallel with different Systems of Organs in the Human Body.

G Simial order: (vascular system.)	F Canine order: (digestive system.)
GG Lemural order: (vascular sense organs.)	FF Feline order: (digestive sense organs.)

E Ursine order: (generative system.)
EE Marsupial order: (generative sense organs.)
D Bimanal order: (nervous system.)
C Equine order: (osseous system.)
BB Hornless ruminants: (vibratory sense organs.)
B Horned ruminants: (muscular system.)
AA Rodental order: (radiatory sense organs.)
A Pachydermal order: (cutaneous system.)

These parallels suppose the nervous system most predominant in man; the digestive system in canine and feline species; the generative peculiarities of structure most predominant in the plantigrade alliance; the cutaneous system in pachydermata; and so of all the rest. We need not dwell on the subdivisions of those orders which are the most simple in this list, but a few words of explanation may be necessary for the others.

By placing the Digitigrade alliance in parallel with the natural subdivisions of the alimentary system in the human body, we shall find the following numerical distinctions of organs and series in both:—

1. The mouth and œsophagus.
2. The stomach.
3. The duodenum.
4. The small intestines.
5. The large bowels.
6. The anus and rectum.
7. The gland ducts of the alimentary system (salivary, pancreatic, hepatic).

The natural families or series of groups in the Digitigrade alliance are the following:—

1. Felidæ.
2. Hyænidæ.
3. Viverridæ.
4. Canidæ.
5. Enhydridæ.
6. Mustelidæ.
7. Profelidæ.

The first four series in this system or alliance need not detain us, as their natural subdivisions are already recognised by systematic zoologists. In the fifth series we place the *walrus*, the *seal*, the *kalan* (enhydra), and the *otter*, as natural genera belonging to one series or family. The sixth series needs no comment, and in the seventh we place the semiplantigrade aberrant genera of digitigrades—namely, *procyon*, *nasua*, *ailurus*, and *cercoleptes*, or racoons, coatis, the panda or wah, and the kinkajou, to which the *binturong* should be added; and probably with this group, instead of with viverridæ, the *suricate* and the *mangue,* or crosarchus obscurus, should be classed.

The Canine order is placed in parallel with the main organs of the alimentary system, and the Feline with those of special sense and articular rank in the same system. Thus, *Felidæ, Viverridæ, Mustelidæ,* and *Profelidæ* form one order, in the majority of which the claws are more or less retractile, as a main distinguishing characteristic; while *Hyænidæ, Canidæ,* and *Enhydridæ,* form another order with unretractile claws, as a leading difference of structural peculiarity. The words canine and feline are perhaps too special to denote these orders; but new names would probably be less convenient.

In the Ursine order we have a like difficulty in the name, as in this general division are included three distinct series or families,—namely, *Ursidæ, Edentidæ,* and *Insectivoridæ.* The latter have been classed as an order, but they are only entitled to rank as a subordinate series in this order.

Nearly all marsupial animals are more or less plantigrade; and as the Ursine order here described are carnivorous, insectivorous, frugivorous, and omnivorous, they are just as well entitled to the rank of a sub-class, as the marsupiata, which have had this honour mainly on account of their diversified habits of feeding. Marsupial types are merely aberrant forms of plantigrade mammalia, neither more numerous in species nor diversified in structure than the rodents, which rank only as an order.

Cheiroptera we class as aberrant forms of Quadrumana; *Sirenia* and *Cetacea* as aberrant types of Pachydermata;—the reasons will be explained in a forthcoming work not yet ready for the press. Meanwhile we may observe that Cuvier, the most eminent of all zoologists, recognised these natural affinities.

It has been said that man is a microcosm, an image of creation as well as of the Creator; and in this view of organic parallels we see a likeness between the microcosm and the macrocosm, organised on the same principle of order, number, and harmony, in every part of the collective unity. This outline of organic method is applied to the mammalian class only of vertebrata; but the individual vertebrate organism corresponds in completeness of parallel to the whole realm of vertebrate organic unity, the connective tissues being parallel with the oviparous classes, and the main tissues with viviparous mammalia; thus,—

Mammals, . .	(principal organic tissues.)
Birds, . . .	(glandular connective tissues.)
Reptiles, . .	(fibrous areolar connective tissues.)
Fishes, . . .	(adipous and serous connective tissues.)

These parallels may be deemed quite arbitrary by those who differ widely from the author in habitual modes of thought; and there is no reason why every one should not hold independent views of natural organic method and of natural science generally, as well as of theology or the interpretation of revealed religion, until final views of natural and spiritual truth enable man to see at once the difference between perfect and imperfect theories in every sphere of thought and understanding. Man knows little, guesses much, and quarrels with the guessings of his neighbour if they differ from his own.

Nature is no more answerable for the shortcomings of "natural science" than Scripture is responsible for the discrepancies of spiritual science or theology. The want of faith in revelation, we may safely say, will not enable us to dive into the mysteries of nature, by the mere conceit of deeming ourselves rational, and those who differ from us, superstitious. Natural science has done nothing yet, nor do we think it ever can do anything, to injure true religion, although popes and theologians have often entertained erroneous views of science, and philosophers erroneous ideas of religion.

On the Inapplicability of the New Term "Dyas" to the "Permian" Group of Rocks, as proposed by Dr Geinitz. By Sir RODERICK IMPEY MURCHISON, F.R.S., D.C.L., LL.D., &c., Director-General of the Geological Survey of Britain.

In the year 1859 M. Marcou proposed to substitute the word "Dyas" for "Permian," and summed up his views by saying that he regarded "the New Red Sandstone, comprising the Dyas and Trias, as a great geologic period, equal in time and space to the Palæozoic epoch or the Graywacke (Silurian and Devonian), the Carboniferous (Mountain-limestone and Coal), the Mesozoic (Jurassic and Cretaceous), the Tertiary (Eocene, Miocene, and Pliocene), and the recent deposits (Quaternary and later)." ! ! *

As that author, who had not been in Russia, criticised the labours and inductions of my associates, de Verneuil and von Keyserling, and myself, in having proposed the word "Permian" for tracts in which he surmised that we had commingled with our Permian deposits much red rock of the age of the Trias, I briefly defended the views I had further sustained by personal examination of the rocks of Permian age in various other countries of Europe.†

It was, indeed, evident that M. Marcou's proposed union of the so-called Dyas and Trias in one natural group could not for a moment be maintained, since there is no conclusion on which geologists and palæontologists are more agreed, than that the series composed of Roth-liegende, Kupfer-Schiefer, Zechstein, &c., forms the uppermost Palæozoic group, and is entirely distinct in all its fossils, animal and vegetable, from the overlying Trias, which forms the true base of the Mesozoic or Secondary rocks.

Owing to such a manifest confusion respecting the true palæontological value of the proposed "Dyas," we should probably never have heard more of the word, had not my distinguished friend, Dr Geinitz of Dresden, recently issued the first volume of his valuable palæontological work, entitled "Dyas, oder die Zechstein-Formation und das Rothliegende."* In borrowing the term "Dyas" from Marcou, Dr Geinitz shows, however, that that author had been entirely mistaken in grouping the deposits so named with the Trias or the Lower Secondary rocks, and necessarily agrees with me in considering the group to be of Palæozoic age.

---

* See "Dyas et Trias de Marcou," Bibliothèque Universelle de Genève, 1859.

† See "American Journal of Science and Arts," 2d series, vol. xxviii. p. 256, —the work of M. Marcou having attracted more attention in America than in England.

As there is no one of my younger cotemporaries for whom I have a greater respect as a man of science, or more regard as a friend, than Dr Geinitz, it is painful, in vindicating the propriety and usefulness of the word "Permian," to be under the necessity of pointing out the misuse and inapplicability of the word "Dyas."

The term "Permian" was proposed twenty years ago for the adoption of geologists, without any reference whatever to the lithological or mineral divisions of the group; for I well knew that a certain order of mineral succession of this group prevailed in one tract, which could not be followed out in another. After surveys during the summers of 1840 and 1841, of extensive regions in Russia in Europe, in which fossil shells of the age of the Zechstein of Germany, and the Magnesian Limestone of England, were found to occur in several courses of limestone, interpolated in *one great series* of red sandstones, marls, pebble-beds, copper-ores, gypsum, &c., and seeing that these varied strata occupied an infinitely larger superficial area than their equivalents in Germany and other parts of Europe, I suggested to my associates, when we were at Moscow in October 1851, that we should employ the term "Permian" as derived from the vast government of that name, over which and several adjacent governments we had traced these deposits.

In a letter addressed to the late venerable Dr Fischer von Waldheim, then the leading naturalist of Moscow, I therefore proposed the term "Permian"† to represent by one unambiguous geographical term a varied mineral group, which neither in Germany nor elsewhere had then received one collective name* adopted by geologists, albeit it was characterised by one typical group only of animal and vegetable remains. As the subdivisions of this group in Germany consisted, in ascending order, of Roth-liegende, with its overlying strata of Weiss-liegende, Kupfer-Schiefer, and Lower and Upper Zechstein, and in England of Lower Red Sandstone and Magnesian Limestone, with other accompanying sands, marls, &c., so well described by Sedgwick,† the name of "Permian"—purposely designed to comprehend these various strata—was readily adopted, and has since been generally used. Even Geinitz himself, as well as his associate Gutbier, published a work under the name of the "Permische System in Sachsen."‡ Naumann has also used the term in reference to the group in other parts of Saxony; whilst Göppert has clearly shown that the rich Permian Flora is peculiar and characteristic of this supra-carboniferous deposit. In England, France, and America, no other term in reference to this group has been used for the last fifteen years.

---

* Leipzig, 1861.

† See Leonhard's "Jahrbuch" of 1842, p. 92; and the "Philosophical Magazine," vol. xix. p. 418, "Sketch of some of the Principal Results of a Geological Survey of Russia."

The chief reason assigned by Geinitz for the substitution of the word "Dyas" is, that in parts of Germany the group is divided into two essential parts only—the Roth-liegende below, and the Zechstein above, the latter being separated abruptly from all overlying deposits.

Now, not doubting that this arrangement suits certain localities, I affirm that it is entirely inapplicable to many other tracts.

---

* It is true that the term Pénéen was formerly proposed by my eminent friend, M. d'Omalius d'Halloy; but as that name, meaning *sterile*, was taken from an insulated mass of conglomerate near Malmédy in Belgium, in which nothing organic was ever discovered, it was manifest that it could not be continued in use as applied to a group which was rich in animal and vegetable productions.

† Trans. Geol. Soc. London, New Series, vol. iii. p. 37.

‡ I may here note that the great Damuda formation of Bengal, with its fossil flora and animal remains, including Saurians and Labyrinthodonts, described by Professor Huxley, has recently been referred (at least provisionally) to the Permian age, by Dr Oldham, the Superintendent of the Geological Survey of India. In fact, Dr Oldham actually cites the plant *Tæniopteris* of the "*Permian beds of Geinitz and Gutbier in Saxony*," in justification of his opinion. (See "Memoirs of the Geological Survey of India," vol. iii. p. 204.)

For, in other regions besides Russia, the series of sands, pebbles, marls, gypseous, cupriferous, and calcareous deposits form but one great series. In short, the Permian deposits are for ever varying. Thus in one district they constitute a *Monas* only, in others a *Dyas*, in a third a *Trias*, and in a fourth a *Tetras*.*

In this way many of the natural sections of the North of Germany differ essentially from those of Saxony; whilst those of Silesia differ still more from each other in their mineral subdivisions, as explained in "Siluria," 2d edition, particularly at p. 342. Near the northern extremity of the Thüringerwald, for example, and especially in the environs of Eisenach, an enormous thickness of the Roth-liegende, in itself exhibiting at least two great and distinct parts, is surmounted by the Zechstein, thus being even so far tripartite, whilst the Zechstein is seen to pass upwards to the east of the town, by nodular limestones, into greenish and red sandy marl and shale, the "Lower Bunter Schiefer" of the German geologists. The same ascending order is seen around the copper-mining tract near Reichelsdorf, as well as in numerous sections on the banks of the Fulda, between Rotheburg and Altmorschen, where the Zechstein crops out as a calcareous band in the middle of escarpments of red, white, and green sandstone.†

But in showing that in many parts of Germany, as well as in England, the Zechstein has a natural, conformable, and unbroken cover of red rock, I never proposed to abstract from the Trias any portion of the Bunter Sandstein or true base of the group, as related to the Muschelkalk by natural connection or by fossils. I simply classed as Permian a peculiar thin red band (Bunter Schiefer), into which I have in many localities traced an upward passage from the Zechstein, and in which no triassic shell or plant has ever been detected.

---

* See "Siluria," 2d edit. 1859, and "Russia in Europe and the Ural Mountains," 1845.

† On two occasions (1853–54) Professor Morris accompanied me, and traced with me these relations of the strata; subsequently, when Mr Rupert Jones (1857) was my companion, we saw other sections clearly exhibiting this upward transition which I have described. Since then, Professor Ramsay, when at Eisenach, convinced himself of the accuracy of the fact that the Zechstein passes up conformably into an overlying red cover. My note-books contain many additional evidences, which I have thought it not necessary to repeat.

On my own part, I long ago expressed my dislike to the term Trias; for in common with many practical geologists who had surveyed various countries where that group abounds, I knew that in numerous tracts the deposits of this age are frequently not divisible into three parts. In central Germany, where the Muschelkalk forms the central band of the group, with its subjacent Bunter Sandstein and the overlying Keuper, the name was indeed well used by Alberti, who first proposed it; but when the same group is followed to the west, the lower of the three divisions, even in Germany, is seen to expand into two bands, which are laid down as separate deposits on geological maps of Ludwig and other authors. In these countries, therefore, the Trias of Alberti's tract has already become a Tetras. In Britain it parts entirely with its central or calcareous band, the Muschelkalk, and is no longer a Trias; but, consisting simply of Bunter Sandstein below, and Keuper above, it is therefore a Dyas; though here again the Geological surveyors have divided the group into four and even into five parts, as the group is laid down upon the map No. 62, " Geographical Survey of Great Britain."

The order of succession in the Permian group all along the western side of the Pennine chain or geographical axis of England, proves the impossibility of applying to it the word "Dyas;" for over wide areas in Shropshire and Staffordshire it is one great red arenaceous series, with a few subordinate courses of calcareous conglomerate. Following it to the north, Mr Binney has demonstrated that the fossils of the Zechstein show themselves in the heart of red marls which occupy on the whole a superior part of such a red series; and in tracing these rocks northwards he has demonstrated that there are, besides, two great underlying masses, first, of conglomerates and breccias, and next of soft red sandstones, the latter attaining, as he believes, a thickness of not less than 2000 feet. Here then the Permian may be considered a Trias. Professor Harkness, in a memoir he is preparing, estimates the thickness of these Lower Sandstones and Conglomerates to the N.E. of West Ormside, in Cumberland, at 4000 to 5000 feet, and shows that they are surmounted by marl-slates bearing plants, thin-bedded red sandstone, grey shale, and sandstone and limestone, the latter—the representative of the Magnesian Limestone—being covered by red argillaceous shale.* Now, in all these cases the Permian is a series divisible into three or more parts. But when we follow the same group into Scotland, it there parts with its calcareous feature, and, becoming one red sandstone of vast thickness, is again a *Monas.*

I have entered into this explanation because my friend, Dr Geinitz, has seized upon one illustration in my work "Siluria," which shows that in certain tracts, where the Zechstein or Magnesian Limestone is subordinate to an enveloping series of sandstones, the Permian of my classification is *there* as much a tripartite Palæozoic group as the Trias of Central Germany is a triple formation of Mesozoic age. Unless, therefore, the data to which my associates and self have appealed, in the work on "Russia and the Ural Mountains," and which I have further developed in Memoirs read before the Geological Society and in my two editions of "Siluria," be shown to be inaccurate, I hold to the opinion that there are tracts in which the Zechstein is simply a fossiliferous zone in a great sandstone series, to which no division by numerals can be logically applied. Even if I do not appeal to the natural evidences in England, Russia, and parts of Germany, but refer to those tracts where the Zechstein or Magnesian Limestone has no natural red cover, I may well ask, Does not the word "Permian," in the sense in which it was originally adopted, serve for every tract wherein the uppermost palæozoic fossil animals and plants are found, whether the strata of which the group is composed form, as in Russia and Silesia, one great series of alternations of plant-bearing sandstones and marls in parts containing bands of fossiliferous limestone, or whether, as in other tracts, the Zechstein stands alone (as near Saalfeld), or in others, again, where the group is tripartite, and even quadripartite? Quite irrespective, however, of the question of whether there are or are not localities in Germany where the Zechstein passes upwards into a red rock, which forms no true part of the Bunter Sandstein of the Trias, we have only to look to the environs of Dresden, on the one hand, and to Lower Silesia on the other, to see the inapplicability of the word " Dyas" to this group.

---

* The red clay or argillaceous shale which covers the limestone is surmounted at Hilton, in Cumberland, by 500 feet of red sandstone, which, though perfectly conformable to the subjacent Permian rocks, he considers to belong to the Bunter Sandstein of the Trias. Here, then, as in Germany, the limestone may have a red cover, and yet the Bunter Sandstein be intact.

Near the capital of Saxony, Dr Geinitz himself pointed out to me that the Roth-liegende is there divided into two very dissimilar parts; and these, if added to the limestone which is there interpolated, or to the true Zechstein of other places, constitute a Trias. Again, Beyrich, in his Map of Lower Silesia,* has divided the vast Roth-liegende of those mountains into Lower and Upper, the two embracing *eight* subdivisions according to that author.

In repeating, then, that the word " Permian" was not originally proposed with the view of affixing to this natural group any number of component parts, but simply as a convenient short term to define the Uppermost Palæozoic group, I refer all geologists to the very words I used in the year 1841, when the name was first suggested. In speaking of the structure of Russia, I thus wrote: " The Carboniferous system is surmounted to the east of the Volga by a vast series of beds of marls, schists, limestones, sandstones, and conglomerates, to which I propose to give the name of " Permian System;" because, although this series represents *as a whole* the Lower New Red Sandstone (Rothe-todte-liegende) and the Magnesian Limestone or Zechstein, yet it cannot be classed exactly, whether by the succession of the strata or their contents, with either of the German or British subdivisions of this age."† . . . . .

After pointing to the governments of Russia over which such Permian rocks ranged, I added: " Of the fossils of this system, some undescribed species of *Producti* might seem to connect the Permian with the Carboniferous era; and other shells, together with fishes and saurians, link it more closely to the period of the Zechstein, whilst its peculiar plants appear to constitute a Flora of a type intermediate between the epochs of the New Red Sandstone or Trias and the Coal-measures. Hence it is that I have ventured to consider this series as worthy of being regarded as a system."*

---

* See also " Siluria," 2d edit. p. 343.

† Phil. Mag. xix. p. 419.

In subsequent years, having personally examined this group in the typical tracts of Germany as well as of Britain, I felt more than ever assured that, from the great local variations of mineral succession of the group, the word "Permian," which might apply to any number of mineral subdivisions, was the most comprehensive and best term which could be used, the more so as it was in harmony with the principle on which the term Silurian had been adopted.

Apart from the question of the substitution of the new word "Dyas" for the older name "Permian," I take this opportunity of expressing my regret that some German geologists are returning to the use of the term "Grauwacke Formation," as if years of hard labour had not been successfully bestowed in elaborating and establishing the different Palæozoic groups, all of which, even including the Lower Carboniferous deposits, were formerly confusedly grouped under the one lithological term of the "Grauwacke Formation."

Respecting as I do the labours of the German geologists who have distinguished themselves in describing the order of the strata and the fossil contents of the group under consideration, I claim no other merit on this point for my colleagues de Verneuil and von Keyserling and myself, than that of having propounded twenty years ago the name of "Permian" to embrace in one natural series those subformations for which no collective name had been adopted. Independently, therefore, of the reasons above given, which show the inapplicability of the word "Dyas," I trust that, in accordance with those rules of priority which guide naturalists, the word "Permian" will be maintained in geological classification.

---

* In my last edition of "Siluria" I have spoken of the Permian as the Uppermost Palæozoic *group*, but have not deemed it a system by comparison with the vast deposits of Carboniferous, Devonian, and Silurian age.

Address delivered at the Opening of the Session of the Royal Society of Edinburgh, on Monday, 2d December 1861, by the Very Rev. Dean Ramsay, LL.D., Vice-President of the Society.

It is with no affectation of humility, it is with no mock modesty that I earnestly bespeak your kind indulgence for the discharge of the duty to which I have been called this evening. My diffidence in this matter arises from no want of interest in the work assigned to me, but from knowing how much I lack that extent of knowledge and that degree of experience which seem to be required for the position in which I am placed, and for such an audience as I have the honour to address. I find different scientific associations adopt different rules. In some cases the secretary makes, in name of the council, a general report of the whole proceedings during the past year; in fact, very much in the business style of the secretary of a railway company. In some cases, the address is delivered on the anniversary of the society by the president, who makes a distribution of its medals and prizes previous to his vacating his office.

The Royal Society of Edinburgh has only of late years adopted the practice of an address from the chair on the first meeting of the Session, with notices of the deceased members during the year; the medals and prizes being distributed usually towards the end of the Session. The address on the first meeting of last Session was delivered by our recently elected President, the Duke of Argyll; and it was well observed on that occasion, I think by Lord Neaves, that the address itself was the best proof of the Society having chosen their President well and wisely.

As to the statistics of the Society, I may mention that eight members have died during the past year:—

Rt. Hon. The Earl of Aberdeen.
Robert Bell, Esq.
Rt. Hon. Lord Campbell.
John Gordon, Esq., of Cairnbulg.
Professor More.
Sir James M. Riddell, Bart.
The Rev. Dr James Robertson.
E. D. Sandford, Esq.

Sixteen new members were elected during the past year:—

W. A. F. Browne, Esq.
The Rev. Thomas Brown.
R. E. Scoresby-Jackson, M.D.
James M'Bain, M.D., R.N.
Professor P. Guthrie Tait.
John Muir, D.C.L.
William Turner, M.B.
W. L. Lindsay, M.D., F.L.S.
James Lorimer, Esq.
Archd. Geikie, Esq., F.G.S.
William Handyside, Esq.
George Berry, Esq.
Thos. Herbert Barker, M.D.
Robert Maclachlan, Esq.
James Young, Esq.
A. E. Mackay, M.D., R.N.

Three members resigned during last year:—

Andrew Murray, Esq.
Brinsley de Courcy Nixon, Esq.
Horatio Ross, Esq.

Total Number of Fellows for 1860, ... 253
" " 1861, including a member not inserted in last list, ... 259

In glancing backwards on the *proceedings* of the last year, it is quite manifest that there has been no falling off in zeal and diligence amongst its members. Besides other business in connection with the objects for which the Society was embodied, thirty-three papers were read at the ordinary meetings. Seven were on subjects connected with Geology; nine with Natural History or Physics; seven with Chemistry and Chemical Analyses; four with Magnetism or Electricity; the rest were of a miscellaneous or biographical character. Without noting particular papers, it is quite enough to say of these communications that they are the result of deep study and careful experiment; that they are fully in accordance with the high and advanced state of the several sciences to which each of them belongs. The only regret I have (a regret which I cannot help expressing) is, that we have not more papers of a literary character. Such papers would be quite in accordance with the original purpose and object of the Society. They would make a pleasing variety, I believe we might almost say a *relaxation* of attention towards the subjects with which our evenings are generally occupied, and (perhaps this is my chief recommendation) they would call forth contributions from some of our members who have not given themselves to the study of physical sciences, but whose present inaction, session after session, we cannot but deplore. We regret to think that we have not occasionally papers on such questions as Moral Philosophy, Political Economy, History, Classics, or Belles-Lettres, from Fellows of the Society, who, we are sure, could execute them so ably and so gracefully. The productions of the last Session, and the attendance at the evening meetings, indicate, then, a continued activity and interest in the cause of science. And we notice this fact as supplying the answer to an objection which we have heard raised against the Royal Society of Edinburgh, and against other associations of the same character, viz., that their day had gone by; that they were well suited to a period when there was little or no scientific current literature, but that their place has been superseded by periodicals—that is, by scientific magazines and journals, to which men of science will now prefer sending their papers, rather than to the less popular and less known Transactions of societies. Experience has proved the objection altogether fallacious. Societies have done for science and literature what could have been accomplished in no other way. There is the advantage of personal intercourse at their meetings, whether ordinary or extraordinary,—of funds for prizes,—of libraries, and of the general prestige of men of high place and high reputation being associated in bodies under sanction of Royal patronage. The Transactions of home and foreign societies would themselves form a scientific library of considerable extent. The library of the Royal Society of London now exceeds 40,000 volumes, chiefly on scientific subjects, and in mathematical works is surpassingly rich. At no time were such associations, either in this country or the continent of Europe, more active and more efficient. No doubt this very activity and efficiency have produced a change, which, to a certain extent, *must* affect the old scientific institutions. The change to which I refer is due not only to the great increase of the *number* of such institutions, but to the great subdivision of the labour in scientific inquiries. The Royal Society of London was founded in 1663. Its general object was the promotion of Science and Literature. The vast number of illustrious names connected with that great Society, and the extent of research manifested in its Transactions, amounting to 200 volumes, are well known to all whom I address. Other similar institutions were formed in London in subsequent years. The Royal Society of Edinburgh followed, and many provincial associations throughout England. Of these the Literary and Philosophical Society of Manchester, instituted 1781, has been long distinguished. Dr Percival was one of its early supporters. His papers, and communications from Mr Dalton, Dr Henry, and others, have ever been had in high esteem. At Liverpool, Bristol, York, Bath, Leeds, Exeter, and other places, large sums of money have been expended in buildings for the meetings, museums, libraries, lecture-rooms of similar societies, and were called forth to meet the growing taste for scientific study, and the vast increase of persons in all professions and ranks of life who delighted in natural history, physical science, and the study of history, of literature, and philosophy. We now find the operations of our learned societies becoming associated with our social system itself.

The *history* of the Royal Society of London becomes an important work, and is, in fact, a history of science itself during the period when the Society was in action.*

In reference to the history of scientific institutions, we can scarcely omit to notice the endeavours that have been made to draw the members closer together in social as well as scientific relations—such as dinners, holding *conversazione* meetings, and other friendly unions. I hope it will not be considered unbecoming in this address to mark how completely the *scientific* association is adapting itself to the *social* system, and becoming part and parcel of common life. It is from this circumstance, I apprehend, that a certain part of the history of the Royal Society of London has lately excited so much attention. An account of it has been printed for private circulation by Admiral Smyth, to whom the necessary documents connected with it were intrusted. I mean its *Dining Club*. The annals of its proceedings commence in 1743; but Admiral Smyth, and others, zealous in all branches of archæology, are persuaded that the club dates much further back. The club was at first called the "Royal Philosophers;" and although the archives of the Royal Society are unfortunately deficient on many points of its proceedings, they are very minute in their account of the dinners of the Royal Philosophers. Thus we have the satisfaction of knowing the precise dinner to which the Royal Philosophers sat down, 27th October 1743—a dinner, let it be remembered, eaten at one o'clock, and a pretty solid one:—

Turkey boiled and oysters.
Calves head hashed.
Fowls and bacon.
Chine of mutton.
Apple-pie.
Two dishes of herring.
Tongue and udder.
Leg of pork and peas.
Sirloin of beef.
Plum-pudding.

---

* History of the Royal Society of London, by Birch.

The dining club is now generally adapted as a concomitant of the learned association, and with very pleasant results But the Royal Society of London were so desirous to consider their dinners part and parcel of the *Society* itself, that it was one of their early rules to fine any member a guinea who called it a club.

The Astronomical Society have long had a dining club in conjunction with their scientific meetings. From what connection or analogy with sidereal investigation I do not know, but one invariable dish at the astronomical dinners is black pudding.

The dining club of the Royal Society of London has evidently, then, been considered a very important appendage; indeed, Admiral Smyth remarks: "The hospitality of the Royal Society Club has been of *material utility* to the well-working of the machine." "This is proved," he goes on to state, "by the number of men of note, both in ability and station, who have there congregated previously to repairing to the evening meeting of the body at large; and many a qualified person, who went thither a guest, has returned a candidate." It has been a sound policy, therefore, as Admiral Smyth conceives, which so early in the history of the Royal Society dictated the formation of a dining club in connection with the more scientific portion of the body. It introduced a bond of unity of a different character from the scientific bond. Dr Johnson and other learned men have attached great importance to their dinner, and were not in humour for pursuing literary thoughts where it was wanting or where it was bad. When the discussions were going on about the propriety of having a cook attached to the French Institute, an eminent Paris judge told La Place, as a reason for having a cook, that he considered the discovery of a new dish far more important than the discovery of a new planet, and added this reason for the opinion: We have already quite enough of planets, but we can never have too many good dishes.

It soon became evident, as years rolled on, that a greater subdivision of scientific labour must follow upon the older societies, formed as they were for general scientific purposes. Enthusiastic cultivators of particular branches of science wanted something more exclusive. The first actual movement in this direction was, I believe, the Linnean Society, founded in 1788 for promoting the study of zoology and botany, as these sciences had been organised and advanced by the immortal naturalist whose name gave the character to the association.

This society had a further division in its Botanical Section promoted by such men as Brown, Lindley, and Hooker, whose object was to pursue, unfettered by the artificial classification of Linnæus, the natural system of Jussieu as a more philosophical system, and already vigorously pursued on the continent by the elder Decandolle and other great botanists. Societies formed for promoting special objects in science and natural history sprung up in every quarter. Thus, we have the Antiquarian Society, the Royal Astronomical Society, the Geographical Society, Geological Society, Entomological Society, the Horticultural Society, the Meteorological Society; and to show the extended character of these subdivisions, I may mention the Royal United Service Institution, exclusively devoted to questions connected with warfare, whether by sea or land. Few persons unconnected with the naval and military professions are aware of its precise object and character, or of the extent of its operations. It is termed the "Royal United Service Institution," because it has a Royal charter. It is in regard to machinery very much like our own.* It has vice-presidents, a library, museum, meetings, and proceedings; papers are read, and transactions published, and the subjects of those papers are all strictly bearing upon military and naval service. To show the character of the topics chosen for these papers, I will read over a few of those already published in their Transactions, many of which, I have been told, are exceedingly able, and admirably illustrated by models, maps, and drawings. For instance, the whole of the number for August is occupied with a dissertation on Iron-Cased Ships, by Captain Halsted, R.N. June number contains a paper on Photography and its Application to Military purposes; another on the Military Forces of the Nations of Europe; one upon Swiss Targets and Rifle Ranges. There is a paper in a late number on National Defence, called the Rifle and the Rampart; one upon the Sanitary Condition of the Army; one upon Recreations for Soldiers and Sailors; one upon Rifled Ordnance, &c.; all connected with warlike affairs. Then there are models of ships, forts, arms, battles; and there is a collection of relics or trophies, naval and military. For example, as to naval relics, there are the sword worn by Nelson when he took the "San Josef," the chronometer used by Cook in his voyages of discovery, the signal book of the "Chesapeake," and many others. As to military relics, they have the swords of Cromwell and of Wolfe, the sash with which Sir John Moore was lowered into his grave, Napoleon and Tippoo Saib's rifles, relics of Waterloo, Inkermann, Sebastopol, and others. The Duke of Wellington took much interest in this institution in all its departments, and entered most kindly into the wishes of the Council regarding digging up and placing the skeleton of his favourite horse, which he rode at Waterloo, into the museum, as already they had the skeleton of the Arab rode by Napoleon at Waterloo. The design never was accomplished, but the museum of relics called forth a quiet jocular remark from the great commander to Sir Charles Napier; and as the jokes of the Duke of Wellington are rare, I may mention it in passing. It is the more amusing, as Napier used to tell the story himself. Whilst the negotiation about the skeleton of the Duke's horse was going on, Charles Napier, the naval officer of the name, had been dining at Walmer Castle with the Duke, as his ship lay in the roads. On going away, Napier was putting on his cocked hat, as he was in uniform. Charles Napier, it is well known, was not very nice as to his wardrobe; and so, as they had been talking about the museum, the Duke, after eyeing the cocked hat, suggested, "Napier, you should put your cocked hat into the museum—just the place for it."

---

* The Crown its Patron.

The immense increase of scientific associations for the furtherance and pursuit of separate branches of human knowledge is no more than what might have been expected, and is, in fact, the natural supply of that vastly increased and increasing demand for knowledge in all departments of study, especially in those which relate to inquiries connected with the physical sciences. Nor does this increase at all act injuriously upon the older societies, or deteriorate from the usefulness or importance of their office. It rather calls out their exertions, and places them in a *more* important position. It was utterly impossible that they should of themselves meet the whole growing demand except by a subdivision of their own body, which would not certainly have been so efficacious an arrangement as the formation of new bodies. These children, if we may so call them, of the parent societies, instead of being rivals and opponents, are I apprehend, their best aids and coadjutors. The younger branches take, as we might say, the heavy work of departments, whilst the older institutions take that general charge which extends itself to the whole field of human knowledge. No subjects are excluded from the parent society, but none should have a monopoly there. Whatever other societies do they are ready to do; and in their Proceedings a full and free admission should be given to those subjects which cannot so properly find a place elsewhere. I cannot help thinking that this great multiplication of associations for the exclusive advancement of so many distinct branches of natural science, should lead the older and parent societies to *extend* as much as possible the basis of their own operations. The student who finds only his own pet study advanced by the association which bears its name, naturally looks for a greater variety of subjects in the Royal Society, to which the name of no particular science is attached. The course now pointed out to us is to take the widest range of questions connected with the pursuit of truth; and this seems to me a strong argument for a more frequent introduction of literary papers. Botanical or entomological societies draw round them only botanists and entomologists: The Royal Society should draw round it men of all pursuits. The continued absence of literary papers naturally excludes the full sympathy and cordial co-operation of those who are keenly interested in literature, but who do not take interest in minute details on scientific questions, whether of natural history or natural philosophy. My argument, then, in one word is this: That as ordinary scientific societies attract only those who pursue the studies to which they are specially dedicated, so the Royal Society is intended to attract and interest all classes of men of research and intelligence. I am aware that I require apology for making these remarks; but I offer them not only under a deep feeling of their importance, but from an assurance that persons whose valuable aid and countenance we would be proud of are kept away, because the Society's papers and discussions are so seldom upon questions other than those connected with physical inquiries.

After these remarks upon the labours of the Society past and future, I would say a few words on those of our body who have departed this life since we met within this hall last December. I think the practice adopted of late years by the Royal Society of Edinburgh, and which has been pursued by other kindred associations,—I mean the practice of introducing, at the opening meeting of every Session, a short biographical reference to the deceased members of the past year,—is a most becoming and appropriate arrangement.

Whilst, on the one hand, it enables the chairman to offer a suitable testimony to many a distinguished example of zeal for literature and science, and of well-directed labour in their cause, and whilst he is thus enabled to enlarge upon ingenious discoveries and useful inventions, at the same time it indicates a very becoming feeling of interest in the Society towards its individual members as fellow-citizens, and as companions embarked in a common cause, and is a graceful recognition of them in their private character, showing the friendly bond by which we are united, as associates of an ancient and distinguished literary and scientific institute. Sir R. Murchison seems to have had this feeling strong in his mind during his address to the Geographical Society in 1859. In taking leave of the chair he says, "With truth, I take leave of my dear friends as the really *good* fellows of the Royal Geographical Society;" and surely the Royal Society of Edinburgh has just cause to be proud of many names who now bear, and who have in times past borne, the title of Fellows. The present roll of the members embraces many persons distinguished not only at home, but amongst the philosophers of Europe. In the list of past members are recorded names imperishable in the annals of history,—names associated with the highest productions of the human mind. This we may fairly say, when amongst our departed members we find such names as Hume, Robertson, Black, Adam Smith, Sir Humphry Davy, Sir Walter Scott. Now, in looking back upon the changes which the past year has made in our list of members, we find that those whom we have lost were all men of a certain degree of weight and influence in their position in society; all were men much respected by their cotemporaries, and men whose death called forth many sincere expressions of sympathy and regret. It is somewhat remarkable that none of these members belonged, properly speaking, to the *scientific* department of the Society. No one had adopted the pursuit of pure mathematics, or their application to the laws of nature. None were geologists, chemists, or naturalists, beyond that general acquaintance and intelligence possessed now by most men of education. Our deceased members were well known, however, in connection with the business of their day. We have to mark a past career which is associated with a high place, indeed the highest place, in the government of the country. We see the vacant places of men who were no ordinary proficients in the discharge of life's duties, and the more particular duties to which *they* were called, whether it were as ministers of state, as judges, as professors in the university, as landed proprietors, as theologians, or lawyers. The following is the list of departed Fellows of the Society:—

Right Hon. the Earl of Aberdeen, K.G. & K.T.
Robert Bell, Esq., Advocate, Edinburgh.
Right Hon. Lord Campbell, London.
John Gordon, Esq., Cairnbulg, Aberdeenshire.
Professor J. Shank More, Edinburgh.
Sir James Miles Riddell, Bart., Strontian.
The Rev. James Robertson, D.D.
E. D. Sandford, Esq., Advocate, Edinburgh.*

Of the late members on our obituary list, the first is the name of a statesman, a man of the world, a scholar, an antiquary. George Hamilton Gordon, K.G. and K.T., fourth Earl of Aberdeen, was born in 1784, and died December 14th, 1860, at the ripe age of seventy-six. Although far from what would be called a man of brilliant talents, or of great powers of oratory, still, during this long life, few men were more distinguished as filling with much ability high and responsible positions, few were more respected for private worth, and few more generally known for scholar-like attainments. Lord Aberdeen was educated at Harrow, where he laid the foundation of a classical taste and acquirement such as I am disposed to think nothing can so effectually accomplish as an English public school. He went to St John's College, Cambridge, and graduated there in 1804. But previous to this he had been attached to the embassy at Paris, and had gone with Lord Cornwallis, who was there as our ambassador to negotiate the Peace of Amiens in 1801. He formed intimacies with many leading men of the day, and commenced that knowledge of continental politics for which he afterwards became so celebrated, and from which he was enabled so long to administer with much skill and ability the Foreign Department of the British Government.

He did not remain long in Paris in 1801, but before returning to England travelled in Greece, where he brought his classical attainments to bear upon his study of the beautiful architectural remains and interesting localities of the country. This sojourn in Greece (when access to foreign parts was less open to British travellers than it is at present) procured for Lord Aberdeen the notice of his kinsman Lord Byron, who in the English Bards and Scotch Reviewers introduced his name with the well known line—

---

* The names are alphabetically arranged.

> "The travelled Thane, Athenian Aberdeen."*

The public official career of Lord Aberdeen; his frequent occupation of high place in the administration of his country's affairs; his close intimacy with the most distinguished foreign public characters of his time, especially his friendship with Guizot and Prince Metternich; his modification of opinion on many points of national policy, and of the high Tory principles with which he commenced life, which ultimately led to his heading a coalition ministry composed of politicians of all shades of opinion; his correspondence with Dr Chalmers on Scottish ecclesiastical matters, and his endeavours to prevent that which was not prevented taking place, viz. the disruption in the Scottish Established Church; his constant and undeviating advocacy of the policy of non-interference on the part of the British Government in continental relations, and his aversion to entering into war with Russia, and the temporary unpopularity which from that cause he incurred with his own countrymen;—these are all now matters of history, and belong to history, and we leave them to the historian.† As a late Fellow of the Royal Society of Edinburgh, we look more to the man and the scholar than to the politician. To whatever part of Lord Aberdeen's career we direct our attention we find everything that claims our respect and approval. As a landed proprietor his whole career was marked by energy, by skill, and great liberality. I am assured that on no property in Scotland were greater changes manifest under the direction of the proprietor than on his; and all changes were improvements. Old persons, I am assured, in the neighbourhood of Haddo House, speak of once barren moors becoming cultivated farms—once sterile tracts of country becoming clothed with beautiful and valuable timber. A friend who was on a visit to him shortly before his death, exclaimed, after

---

* In 1813 he returned to the Continent, and was our ambassador to the Austrian Court; there he was long engaged in cementing the alliance formed against the power of Napoleon. He was present at many great battles.—Lutzen, Dresden, Leipsic—Moreau died in his tent at Dresden; and it was his impressions received from these dreadful battles that gave Lord Aberdeen that great horror he entertained for war through life.

† A kind friend informs me that the best account of Lord Aberdeen's public life is a memoir by Comte de Jaumais, in the "Revue de deux Mondes." But I have not had time or opportunity for consulting it.

Lord Aberdeen had been pointing out to him the success of his plantations in magnificent and extensive woods, "You don't mean that you planted all these yourself?" "Yes," replied the peer; "and perhaps you will believe what I have before told you, that my line was not politics, but farming." In this light of a Scottish proprietor, we must ever consider him as a patriotic and judicious benefactor of his country. Lord Aberdeen was for many years the efficient President of the Antiquarian Society of London, and no one was more fitted for such an honour. He was an accurate scholar, and a patient investigator into the remains of antiquity. It is curious to observe how Lord Aberdeen preserved, through all the circumstances and stirring incidents of an unusually exciting period of public affairs, the love of classical literature which he had imbibed at Harrow, at Cambridge, and at Athens. His mind had been early imbued with a fine taste for the best writers of Greece and Rome, and the effects were visible to the last. It is often, I believe, thus a taste for life—

> "Quo semel est imbuta, recens servabit odorem
> Testa diu."

We have specimens of his accurate scholarship and ingenious criticisms in his contributions to Walpole's "Memoirs on Turkey," and in his work on the "Beauty of Grecian Architecture."

In 1817 a book was published entitled "Memoirs Relating to European and Asiatic Turkey, Edited from MS. Journals, by Robert Walpole." It consisted of such extracts from the journals and portfolios of intelligent and learned travellers, who had of late years visited that interesting portion of the globe, as were calculated to throw light upon its present condition and ancient grandeur, its geography, antiquities, and natural history, recorded, too, in their own language. It is a very valuable and interesting collection. Amongst these papers are some very learned dissertations by Lord Aberdeen; one of these is upon the gold and silver coinage of Athens. A curious question had been agitated by scholars on the subject of Attic coinage, and many learned men have held that the Athenians never coined gold money at all. There was no doubt gold money, but it seems to have been in coins of other countries. Gold coin seems to have been the *stater* of Persia or Egina, or the ancient *δαϱειϰος*, so called from Darius. Aristophanes speaks of gold coinage, but in his mocking way calls the pieces *ϖονηϱα χαλϰια*, which is not, as Corsini thinks, *copper* morey, but base gold money,—*i.e.*, gold alloyed with copper. Now, Lord Aberdeen discusses the question with much learning and ingenuity; and I will give his conclusion in his own words, as a specimen of his critical style, because scholars are agreed that he settles the question by a more satisfactory explanation of the difficulty than had been given by others.

"The currency of the SILVER money of Athens was almost universal, owing to the deservedly high reputation for purity which it possessed; and on this account we find several cities of Crete copying precisely in their coins the design, weight, and execution of the Attic tetradrachm, in order to facilitate their intercourse with the barbarians. It is possible that the general use and estimation of the produce of the Attic mines contributed to render the Athenians averse from a coinage of another metal, which, by supplying the place of silver money at home, might in some degree tend to lessen its reputation abroad."

"The Attic silver was of acknowledged purity, and circulated very extensively; the Athenian merchants, particularly in their commercial dealings with the more distant and barbarous nations, appear frequently to have made their payments in it. The barbarians, being once impressed with these notions of its purity, the Government of Athens, in all probability, was afraid materially to change that styled appearance by which their money was known and valued among these people. A similar proceeding in the state of Venice throws the strongest light on the practice of the Athenians. The Venetian sechin is perhaps the most unseemly of the coins of modern Europe. It has long been the current gold of the Turkish empire, in which its purity is universally and justly esteemed; any change in its appearance on the part of the Venetian Government would have tended to create distrust."

Lord Aberdeen in this volume gives an account also of two curious sculpture marbles found at Amyclæ in Lacaonia. Each of these two marbles represents a hand-basin surrounded with various implements of a female toilet—such as combs, pins, a bodkin, perfume-boxes, bottles, mirrors, curling-irons, toothpicks, and reticules, or, as some learned men believe, nightcaps. On one of these stones is an inscription containing the words, *Ανθουση υποστατρια;* on the other an inscription containing the words, *λαοαγητα* and *ιερεια.* These by some are supposed to signify two priestesses—Anthusa and Laoageta being supposed the names of priestesses by whom the stones were dedicated.* Others, again, consider στατρια to be nothing more than a hairdresser, and υποστατρια, an under-hairdresser—the same as an ἐμπλεκτρια, or a tirewoman; and the stones, therefore, to be a sort of advertisement of their profession by Anthusa and Laoageta. Lord Aberdeen follows out these nice and critical inquiries with much learning and much patience, and with similar clear and convincing effects as in the case of the Attic tetradrachms.

The treatise of Lord Aberdeen, of which the title is "An Inquiry into the Principles of Beauty in Grecian Architecture," was originally contributed as a preface to Mr Wilkins' translation of Vitruvius. It was published afterwards in a separate form by the author, and has lately been brought out by Mr Weale, the architectural publisher, at the moderate price of one shilling. If we knew nothing of Lord Aberdeen's scholarship except by this treatise, we should have abundant proof of its accuracy, its elegance, and its extent. The essay shows a masterly hand in treating the subject. Nearly all the celebrated buildings of ancient Greece are brought before the reader, and their characteristic features are discriminated with a skilful touch. The whole question of the origin of architectural forms is discussed in reference to the inquiry into the principles of beauty in Greek architecture, although I cannot help thinking that he loses sight of that point at times. Lord Aberdeen disputes, and indeed refutes, the theory of Burke on the sublime and beautiful, and supports himself the theory of beauty as grounded on association—the theory of Mr Alison, as developed in his Essay on Taste, and as admirably supported and illustrated by Francis Jeffrey in his celebrated critique on Mr Alison in the "Edinburgh Review." I would speak with much diffidence on such a question, but I cannot help thinking there is very little satisfaction in these *theories* of beauty, and inquiries into the *principles* of beauty. The idea of beauty is too refined and too delicate to admit of such analyses and dissections. The application of female dialectics to beauty, vulgarly called a woman's reason, is after all more satisfactory than analysis and theory. It is beautiful, *because* it is beautiful; so we say of the orders of Greek architecture. There is a severe and simple grandeur in the Doric, with its firm-set columns, its massive triglyphs, and deep entablature; there is a grace in the Ionic, with its more slender

---

[*] As the κοσμητριαι, or ornamenters of some deity.

shaft and beautiful volute; there is an elegance combined with rich luxuriance in the Corinthian, with its acanths capital,—which baffle all theory, which speak to the eye without any explanation being needed on the grounds *why* they should be admired. These remarks, however, affect not the great merit of the treatise I speak of. Lord Aberdeen's work on Grecian architecture is a work which no one should be ignorant of who desires to see the subject handled with scholarship, taste, and discernment.

It is always interesting to know something of the personal appearance, the ordinary address and manners, of the distinguished dead. Lord Aberdeen, though a man of high birth, of public status, of elegant and refined tastes, was to a great degree plain and unpretending in manner. He had, perhaps, a good deal of that cold and reserved demeanour which obtains for the British character, especially for those in high positions, the name of an exclusive, haughty treatment of others. It is often, as in the case of Lord Aberdeen, a most fallacious mark of the real feeling and the true kindness of the heart within. I might have spoken on this point in some measure from my own observation, as I had the honour of personally knowing Lord Aberdeen. But I prefer offering the picture of Lord Aberdeen's personal appearance and manner as they were observed from a different and most impartial point of view,—I mean as they struck the mind of a stranger, and that stranger a visitor from the United States. In the year 1835 a literary gentleman, Mr N. P. Willis, from America, visited this country for the express purpose of writing a tour, which was published in due time under the title of "Pencillings by the Way." He had been introduced to the Earl of Dalhousie, father of the late distinguished Marquis of Dalhousie, and was received at Dalhousie Castle, where I met him,—and an acute, unscrupulous observer he was. Lord Dalhousie introduced him to the late Duke of Gordon, and at Gordon Castle he was introduced to the late Lord Aberdeen, of whom he thus writes:—

"Lord Aberdeen has the name of being the proudest and coldest aristocrat of England. It is amusing to see the person who bears such a character.

"He is of the middle height, rather clumsily made, with an address more of sober dignity than of pride or reserve. With a black coat much worn, and always too large for him,—a pair of coarse check trousers, very ill made,—a waistcoat buttoned up to his throat, and a cravat of the most primitive *negligé*. His aristocracy is certainly not in his dress. His manners are of absolute simplicity, amounting almost to want of style. He crosses his hands behind him and balances on his heels; in conversation, his voice is low and cold, and he seldom smiles. Yet there is a certain benignity in his countenance, and an indefinable superiority and high breeding in his simple address, that would betray his rank after a few minutes' conversation to any shrewd observer. It is only in his manner toward the ladies of the party that he would be *immediately* distinguishable from men of lower rank." (*N. P. Willis' Pencilling by the Way.*)

Here we find an American tourist brought into contact with the British nobleman, surprised at not finding a man exhibiting all the artificial graces which he had supposed were shadowed forth for all men of rank in England by Chesterfield's Letters; and yet the republican has acutness enough to discern, under the cold and simple demeanour of the peer, the high estimable qualities of head and heart by which his character was impressed. He feels how much lies beneath, and he is impressed with respect and admiration. He was right in the estimate he formed of him; and further acquaintance would only have deepened the impression of his high qualities. From one who had the first opportunities of judging, I have this testimony, that "he considered him the *best* man he ever knew. That he really believed he was incapable of even comprehending anything mean or ignoble." Such, then, was Lord Aberdeen in his various relations and features of character. He was no ordinary man,—consider him as a statesman or scholar, a man of property, or in his more private relations of life. It is a great blessing when men who are called upon to take so prominent a place in public affairs are really *good* men. The Royal Society of Edinburgh, of which he was a member for years, his family, his country, respect the memory of the late Earl of Aberdeen.

Mr Robert Bell, was son of Benjamin Bell, the celebrated surgeon. He was born in 1782, was educated at the High School of Edinburgh, and was called to the bar in 1809. He must soon have gained some reputation as a lawyer, as he appears in an early caricature of Kay as one of those advocates who pleaded in a wig.

From this period he gradually attained considerable practice. He was made Procurator for the Church of Scotland, and Sheriff of Berwickshire in 1842. Mr Bell had, besides his legal acquirements, a highly cultivated mind. He was fond of mathematical reasoning as a recreation, and did not further apply it. In art he had excellent taste ; and indeed was considered by picture-dealers to have great knowledge of the old Masters, and much tact to discriminate their styles. He made, from his own judgment, a collection of Rembrandt etchings, considered one of the most complete in the kingdom. Mr Bell was a member of the Bannatyne Club, and not an inactive member. He was a great reader, and deeply conversant especially with works on philology. Those who knew him well bear high testimony to his varied powers of conversation, and his skill in discussing and elucidating subjects that were brought forward in society.

A certain George Campbell having injured his property by adherence to his chief, the first Marquis of Argyle, during the trying times of the Covenant in 1662, left the Highlands, and became the proprietor of the estate of Baltulla in the neighbourhood of St Andrews. The great-grandson of that George Campbell was the Rev. Dr George Campbell, for fifty-four years the minister of Cupar-Fife. In 1776, Dr Campbell married Miss Hallyburton, who was connected with some Scottish families of rank, of whom one was Wedderburn, Lord Chancellor. The fruit of this marriage was five daughters and two sons. Of the sons, the elder was Sir G. Campbell of Edenwood ; the second was John Campbell, born at Springfield, near Cupar, September 15, 1781, afterwards destined to rise by his own talents and industry to become a peer of the realm, Chief-Justice of the Queen's Bench, and Lord Chancellor of England. Lord Campbell was always proud of his connection with the Argyle family and with Scotland .He showed this by his kindly and interested allusions to the Campbell clan, which very frequently show themselves in his "Lives of the Chancellors ;" and when Lord Chancellor himself he marked his feelings as a Scotchman by thanking most warmly the author of an idle book, called "Reminiscences of Scottish Life and Character," when the writer was presented to him, for the great pleasure he had derived from these old stories of a bygone Scottish race. He showed also more decidedly his love for Scotland by purchasing Scottish property, and living in Scotland as much as he was able. I have observed that in all his publications he is very particular in having F.R.S.E. appended to his name as author.

Lord Campbell was educated at St Andrews, where he was a cotemporary of Thomas Chalmers and of David Wilkie; though younger than either, for it appears he entered St Andrews at the precocious age of ten. Young Campbell was intended for the ministry, but he soon found that his calling was not to the Church. His sense of unfitness for clerical studies, joined with ambition to shine at the English bar, led him to London. Mr Sergeant Spankey, then editor of the "Morning Chronicle," gave him employment as reporter and critic. He seemed to have retained his connection with that paper up to 1810, and, what is curious, chiefly as a dramatic critic, writing theatrical articles. Young Campbell showed also at this time that he could claim resemblance to accomplished Roman lawyers, and, for example, to one celebrated by Horace—Asinius Pollio—who was not only a lawyer and statesman, historian, and conversant with the "musa tragœdiæ," but *soldier* also, as Campbell had joined the Bloomsbury and Inns of Court Volunteers, which consisted exclusively of barristers, attorneys, law-students, and clerks. To this circumstance he jocularly referred in after life, in a suit he was trying connected with a volunteer regiment, by saying that he had himself once been a soldier, as a member of the corps, composed as I have said of diverse members of the legal profession, and which he referred to as well known in the capital under the name of *The Devil's Own.* His great object, however, was *law.* He entered as a student of Lincoln's-Inn in 1800, and commenced special pleading under that great master of the art, Mr Tidd, who at one time could point to four pupils of his own sitting in the House of Peers,—Lords Lyndhurst, Denman, Cottenham, Campbell,—all of whom constantly acknowledged their deep obligation to their master. He was called to the bar in 1806, and went the Oxford Circuit, where he soon obtained considerable practice. It was to London business, however, that he looked, and he was soon in great London practice—getting high fees in shipping cases, and in special jury cases at Guildhall. It is well known that in establishing practice for a young lawyer much depends upon the favour with which he is regarded by the attorneys. Lord Campbell in his "Life of Pratt," Chief-Justice of the King's Bench, and father of the Marquis of Campden, says of him, that for eight or nine years his practice did not improve, because he would not invite the attorneys to dinner, or dance with their daughters. Whether Campbell was a dancing man, or whether he danced with attorneys' daughters, I know not. But it is clear that he took a better and a more lawyer-like plan of gaining the favour of their papas than either dancing or dining. He published a series of Reports of Cases decided at *Nisi Prius* between 1809 and 1816, which was not only in itself very valuable, and established his reputation as a lawyer, but which specially interested the body of solicitors, as the work contained for the first time the names of the attorneys who had got up each case. He had thus very early a great connection with the solicitors, and came into a lucrative and immense business. He soon became leader on the Oxford Circuit. In 1827 he obtained a silk gown. In 1830 he came into Parliament for Stafford. In 1832, was Solicitor-General in the Melbourne Ministry, and was returned to Parliament for Dudley. In 1834, he became Attorney-General on the retirement of Sir William Horne, but lost his seat for Dudley. On Mr Jeffrey's elevation to the Scottish Bench, and consequent retirement from the representation of Edinburgh, Sir John Campbell was returned as one of our city members, and sat till 1841.* Several very important cases in the common law-courts occurred whilst he was Attorney-General, in which he had to take a prominent part. One of his most conspicuous efforts was his defence of Lord Melbourne, the prime-minister, in the action brought by Mr Norton. Campbell's defence was considered so masterly, and the gaining the cause so important to the stability of the administration, that when Campbell entered the House of Commons the evening of the trial, he was generally and loudly cheered by the members on the ministerial side of the House, as a testimony to his skill in managing the case. and his ingenuity in cross-examining the adverse witnesses. At this period many law appointments had to be made, but Sir John Campbell still continued Attorney-General. A purpose of bringing him into the House of Peers to assist in deciding appeal cases failed, as did also a plan for making him Chancellor of Ireland. On Lord Plunket's retirement, however, from that office, Sir John Campbell, June 1841, was made a Peer and Chancellor of Ireland. He held the office a very short time, indeed I believe he only sat as judge twice. In the following September, he resigned along with the Melbourne ministry, and for five years lived without office, profession—salary or pension. His mind could not be idle. He took to literary pursuits, and reverted with great zest to the classical studies of his early days. He found, however, the disadvantages of study without object, and accordingly concentrated his attention on a subject congenial with his tastes, and calculated to call forth his powers. He determined to write the Lives of the Chancellors, and of the Chief-Justices of England. The first series of the former was published in 1846, and immediately attained a popularity which has continued to attend both works. When Lord John Russell's cabinet was formed in 1846, it was expected that Lord Campbell would have been Chancellor. He accepted, however, the less important office of Chancellor of the Duchy of Lancaster, with a seat in the cabinet. This did not prevent his pursuing his literary labours; but in 1850 he returned to his more active legal occupations, as, on the resignation of Lord Denman, he became Chief-Justice of the Queen's Bench. It was a trial to succeed Denman, a man of a noble presence, and dignified eloquence. Lord Campbell, without these, carried universal respect by his accurate knowledge of law, his industry, his discretion, and impartiality. In 1859 he became the Chancellor of Lord Palmerston's administration. This was a second trial for him to undergo. Having hitherto been exclusively practised in the administration of common law, it might be expected he would feel embarrassed as presiding in Chancery, and the House of Lords. But his sagacity and his diligence were again triumphant. He lost nothing of the reputation he brought with him from the Queen's Bench. He is said to have been the only Chancellor taken from the common law, in whom it was impossible to detect the slightest embarrassment in the new position to which he was transferred, and amidst the new principles on which he had to adjudicate. His judgments in equity have universally been deemed of the highest authority. It is a striking proof of the activity of Lord Campbell's mind, and his readiness, to occupy his time and thoughts with questions not immediately connected with his professional occupation, that he should have sustained so long and so important a literary effort, as writing the lives of the Lord Chancellors and Lord Chief-Justices of the Queen's Bench. There is no question of its being a work of great research, great impartiality, and full of acute and able remarks ; the stores of information are at once various and minute ; the style is far from being polished, but he is always clear and intelligible to his reader ; he has done his work thoroughly and well. He happily unites the office of the lawyer and the historian ; for the careful law-student of the work will find in the personal history of our Chancellors and Chief-Justices that there is also pervading it a history of our *jurisprudence.* He will trace the gradual establishment of its sounder principles, he will mark the correction of what had been vague or erroneous.

---

* Sir John Campbell, whilst a member of the House of Commons, did good service to the country by promoting at all times the cause of legal reforms. He introduced two very important bills which are known by his name. One for the protection of proprietors of newspapers who had inserted libels without malice of purpose, and having made due apologies. The other for the protection of persons against malicious arrest for debts which were not due. The latter arose out of a famous case of arrest, and great hardship, of the Duke of Caduval on a false affidavit.

But there is another and a more striking indication of the activity of his mind, and the versatility of his talent, as regards questions which did not come before him as a judge, which is contained in his letter to Mr Payne Collier, on the Legal Acquirements of Shakspeare. He had glanced at this subject in his "Lives of the Chancellors and Chief-Justices." But in this letter, he brings forward the arguments in favour of an opinion, which had for sometime been gaining ground amongst the admirers of Shakspeare—viz., that before he went to London for his theatrical life, he had been clerk in an attorney's office at Stratford. There are some cotemporary circumstances which seem to lead to this opinion, and these Lord Campbell states in the opening of the letter ; but his chief argument is derived from the corroborative evidence supplied by passages selected from his plays. He quotes from twenty-three plays, and he conceives that the passages he quotes give a *probable* evidence that they must have been written by one who had once been a professional lawyer, and familiar with its technical language. I have heard persons speak rather in a depreciating manner of this little production, and who seemed to consider it as unworthy of Lord Campbell, and in fact as in itself of little interest. I am much surprised at this opinion. I think the case is made out in a very ingenious manner; and surely it cannot be a matter devoid of interest to trace back any of the sentiments and expressions of Shakspeare to their original sources, and to analyse the materials of a mind like his. That Shakspeare who drew his imagery and his topics from all sources in society and in nature, should refer in a general manner to the legal profession, and to lawyers, as a peculiar and marked class of civil life, could have caused no surprise. It would have been quite natural. But when he uses such technical language as can be familiar to professional men only, when his illustrations imply an accurate knowledge of legal principles not generally known, we feel assured that there must be some special cause for materials of such a character being introduced into his writings so frequently and so minutely. It was natural enough, for example, that Shakspeare should say of skilful lawyers, "good counsellors lack no clients," or of lawyers, who are idle in vacation time, that they "sleep between term and term," or that he should call time "the common arbitrator." That Gratiano would propose for Shylock, besides his two godfathers, when he became a Christian, *ten more*, meaning that he would have him before a jury to be tried for an attempt to murder Bassanio; or that the fool in Lear should say that the maxims which the old king declared were "nothing," were like "the breath of an unfeed lawyer, given to the king for nothing," and many other examples. But it is very different when he uses terms and makes representations, which imply a knowledge of nice points of law, and points not generally known, except by professional men. As, for instance, in the "Merry Wives of Windsor," Ford says, that "his love was like a fair house, built upon another man's ground, so that he had lost his edifice by mistaking the place where he erected it," showing that Shakspeare had a knowledge of real property not generally possessed,—viz., the knowledge of that maxim of lawyers applicable to land: "cujus est solum, ejus est usque ad cœlum," under which any house erected on a freehold becomes the absolute property of the soil,—so that the luckless builder cannot remove any of the most costly adjuncts of his building, such as the finely-carved chimney-pieces, or expensive marble pillars, with which he may have adorned the edifice. A passage in the "Comedy of Errors" draws out a most circumstantial and graphic account of what is called in English law "Arrest on Mesne Process in an action on the case." No one could have adopted the phraseology in the conversation between Adriano and Dromio, who had not a technical acquaintance with the point of law so named. It is very curious also, that Shakspeare, in the grave-diggers' scene, where he speaks in a ludicrous tone of "Crowner's Quest Law,"—*i.e.*, the law as laid down by a coroner when he holds an inquest on a dead body—should show his intimate knowledge of a celebrated case of *felo de se*, tried in the reign of Philip and Mary before a coroner, and which was afterwards brought into the higher courts. The case had been reported by the famous Plowden, and Shakspeare evidently intended to ridicule the counsel who argued, and the judge who decided it. Hamlet's own speech quotes a string of technicalities, with the meaning of which the author is apparently familiar,—such as speaking of a lawyer's recognisances, his fines, his double vouchers, his recoveries, and of these vouchers, whether single or double, vouching him no more of his purchases than a pair of indentures,—and of which Lord Campbell declares that it would puzzle practising barristers of his acquaintance to define each satisfactorily; and let it be remembered, that Lord Campbell quotes upwards of sixty examples of such law passages more or less to the point. Whether Shakspeare were or were not trained in an attorney's office can never now be known beyond conjecture, but the book shows Lord Campbell's ingenuity, and his readiness on a question of law and literature in curious combination.

Such is a brief sketch of the active and varied life of John Lord Campbell. He was assuredly a very able man, and has achieved a name in his country's annals which will not pass away. The leading characteristic of his mind, as I have always heard from those who knew him best, was *determination*— a firm resolve to accomplish his object before him, and to attain the highest place in the path he had set himself to pursue. His efforts were successful, and he never relaxed in his diligence, never swerved from duty. A little incident will illustrate this adherence to what he considered was incumbent on him to accomplish, at all risks to his own personal convenience. When the naval review took place at Portsmouth, in 1853, the nobility and leading commoners of the empire were to attend, and a steamer was appointed to convey the whole House of Lords from Southampton, and to bring them back to the same point when the review was done. They were obliged to start from London, the day of the review, at four in the morning, One mishap succeeded another, so that the party did not reach Southampton till three the following morning, and were not in London till six. Notwithstanding all the fatigue and delay of so long an expedition, Lord Campbell, then Chief-Justice of the Queen's Bench, was enabled to state in the House of Lords, with great complacency, when complaints were made of the bad arrangement of the expedition, that the suitors had not suffered from the mismanagement, as he had taken his seat in Queen's Bench at the usual hour, half-past nine. He was then seventy-two.

Lord Campbell owed his success in life entirely to his own exertions, and his own innate powers of mind. He had not those external accessories of address or grace to which men are sometimes indebted for much of their success, and from which they gain artificial advantage in the public eye and estimation. He was plain, in his exterior, nor had he a polished style of writing or of speaking. He had nothing of what is usually termed eloquence, and yet all he said and wrote *told* and produced good effect. Like Lord Aberdeen, he enjoyed in his lifetime the respect and consideration due to his talents and his success, but which are posthumous to so many good and able men. For him a cotemporary might very properly use the address made to Augustus, "*Presenti* tibi maturos largiamur honores."

Lord Campbell never felt what so many able men feel before they have to give up their place in this world,—viz., that "multa senem circumveniunt incommoda." He had only *one* of those two seasons of childhood which Shakspeare has assigned to every human being, nor could he ever have said with Lear :—

> "Infirmity doth still neglect all office,
> To which our *health* is bound."

He died in his eightieth year, in the midst of full occupation as a statesman and a judge, and with faculties, I believe, quite unimpaired. Few men can hope ever to attain Lord Campbell's eminence; few can expect to reach his years without infirmity and decay of mental and bodily faculties. But all may imitate his example in the fixed determination to do their utmost in the path which Providence has assigned to them, and all may follow him in the full resolve faithfully and honestly to discharge every duty for which they have become responsible.*

John Gordon, Esq. of Cairnbulg, who died during the present year at an advanced age, had long been a Fellow of the Royal Society. He spent many years in Edinburgh, and at one time was in some practice as an advocate. I recollect him a regular attendant on the Society's meetings. But his natural bent was towards the duties and avocations of a country gentleman. These occupied his attention during the later years of his life. But he joined, with all his pursuits, a love of literature to the last, and, with much intelligence, took great interest in everything that was going on at home or abroad in the fields of scientific and literary inquiry.

---

* Those who best knew Lord Campbell in *private* life bear testimony to his amiable and affectionate deportment in the domestic circle. To his habitual unselfishness, which made him seek the comfort and happiness of every one before his own, and to the freshness and simplicity with which he enjoyed, with young people especially, the few simple pleasures for which his immense labours left him time.

John Schank More was born at North Shields in 1784, where his father was the respected pastor of a congregation in connection with the first seceders from the Scottish Established Church. He was educated in Edinburgh, and had an early predilection for the bar, to which he was called in 1806. He had good practice as a junior counsel, but he soon showed that his bent was rather to the teaching of the profession, and the exposition of the general principles of law as its expounder, than to the practice of court. In 1827 he published an edition of "Erskine's Principles of the Law of Scotland," a very useful manual for guiding young students to a correct knowledge of that standard manual. But in 1832 he published his most important work, his edition of Lord Stair's "Institutions of the Law of Scotland, with Notes and Illustrations." Lord Stair's work was the production of a most philosophical mind, as well as of a profound lawyer. It contains more than a digest of municipal law, it contains an able treatise of general jurisprudence. His illustration of such a work, therefore, fell in with Professor More's peculiar habits of mind and thought. I have been assured by an eminent Scottish lawyer, that he was particularly happy in bringing forward all circumstances in illustration of his abstract law principles, whether derived from home or foreign sources. He had extraordinary knowledge of what may be termed the *literature* of the law. Hence his edition of Stair has taken its place as a standard work, and is quoted for general principles, both at the bar in argument, and on the bench in judgment. A course of study producing such happy results as the Professor's labours in the two great works of Erskine and Stair must have been recognised as the best preparation for a legal chair, and the best proof of fitness for its occupancy. Accordingly, in 1843, on the death of Professor John Joseph Bell, he succeeded to the chair of Scots Law in the University of Edinburgh. It would be unbecoming, in one not a lawyer, to pretend giving a judgment on the merits of a professor's teaching of law. But that he performed his work under a solemn sense of duty—that he spared no pains to make his class understand the principles and the details of a science which he had diligently and successfully studied himself, is a matter of general notoriety, and the public papers, at the time of his death, all bore testimony to his merits as a professor. One feature of his professional work was very remarkable, and attested by every hard-working student, I mean the unwearied pains he took in going over their papers, and the careful manner in which he corrected the essays sent in to him. There may be something animating and attractive in looking over the exercises and theses of Scots law students, I am unable to judge of this, but I should think, in general, such examinations must be a dreary portion of any professor's labours. But Professor More never seemed to weary. He never intermitted his care, and seemed always fresh for doing, and doing kindly, what he considered an act of duty by his pupils. Professor More, in fact, made his studies, and everything connected with his profession, a part of his daily and ordinary life. He enjoyed books, because he made good use of them, and he had collected a library of upwards of 15,000 volumes. These books were his delight—his companions in solitude, his comfort in the tedium of hours of sickness. He could turn at once to the volume he wanted, and to the passage he desired to recall. When I say his books were his companions, I might rather have said the *authors* were his companions. In a letter to one of his family, shortly before his death, he draws in himself a pleasing picture of an old man in his study surrounded by his books, and holding converse with his favourite authors:—

"While reading Leighton quietly in my own room, it struck me that the old man was really sitting with me, and conversing familiarly upon those topics which so entirely engrossed his own mind; and it is a curious reflection that, with such books, I have been conversing as truly with Horsley, Hooker, and Leighton as if they had risen from their graves and sat by me."

Whilst I remark the Professor's liberality of feeling in naming as his favourites three authors who were *not* members of his own Church, I think my hearers will excuse some personal feelings of pride and satisfaction in observing that Leighton, Horsley, and Hooker are ornaments of my own Church.

There is a circumstance connected with the late Professor's library which was so peculiar that I cannot resist referring to it. He was a most indefatigable collector of PAMPHLETS, and formed the largest collection of a private individual, I believe, in Scotland; and it is always curious to notice what any man has done different from other men. Some years ago I had the honour of reading before this Society a memoir of my illustrious friend Dr Chalmers. Professor More heard of my intention, and very kindly offered me the use of a volume, which he had collected, of sermons, memoirs, poems, &c., all relating to Dr Chalmers. I found this one of a series of volumes of collected fugitive pieces, then amounting to 700 or 800; but which, before he died, the Professor had raised to the number of 1400 volumes,—that is, about 14,000 pamphlets. It would be desirable that the volumes should be purchased unbroken for some public library. Such collections are very valuable for reference. Single pamphlets, lying loose in a library, are a regular nuisance, and most troublesome, always getting in the way; but if you look for any particular pamphlet you never find it. Pamphlets, however, when formed into such a collection as this, are a very different matter, and may, as I have said, be extremely valuable, as affording to future students of history very important information on cotemporary circumstances, which is sometimes not otherwise to be obtained; and for this reason some rare and curious pamphlets have been sold for enormous prices, and are much coveted by collectors. One of the most curious historical collections of pamphlets in this kingdom is that in the British Museum, which was presented in 1763, by George III., to the library of that gigantic institution. It was made by a royalist bookseller, named George Thomson, during the Commonwealth. It consists of 2220 volumes, and contains about 34,000 pamphlets, nearly all of which refer to the civil wars, and to the affairs of the country between 1640 and 1661. To show the comparative extent of Professor More's collection by a private individual, as compared with public collections, I may note here that the Edinburgh Subscription Library is advertised to contain 600 volumes, or about 1600 pamphlets; the Signet Library contains about 5000 pamphlets; the College Library about 25,000; and the Advocates Library near 67,000 pamphlets, or 3649 volumes. In catalogues of books, such as Dr Parr's "Bibliotheca Parriana," and other celebrated sale catalogues, there is generally a pretty copious account of the rarer tracts and pamphlets contained in the collection to which the catalogue belongs. But there is a *history* of pamphlets, which is one of the most extraordinary books in the English language, published in London 1715,—a book well known to librarians and collectors. The author was Myles Davies, who seems to have been odd and eccentric to the last degree. He was very poor, and wrote for bread; very learned and of great research, but his style rambling and grotesque. The work, in six volumes, is very scarce, indeed it is esteemed amongst the rarest books in bibliography, and is entitled, *Εικων μικρο-βιβλικη*—"Sive Icon Libellorum," (what we should call in Scotch "little bookies,") or a critical history of pamphlets, &c. &c. In a long, rambling preface, he enters upon a history of pamphlets, and describes their different uses and qualities. He very coolly says in the preface:—"We need not go farther back than 2000 years *before* the creation of the world." Some Jewish rabbins having profanely asserted that heaven itself had at that time written the small volume containing the synagogue rule of their law; and he quotes Saldenus, a Dutch divine, who, in the first of forty-one erudite dissertations (Amsterdam, 1684), combats the rabbinical opinion, that Adam and each of the patriarchs had written a pamphlet. Davies dedicates the sixth volume of his history of pamphlets to his patron, Dr Crowe, and addresses him in this complimentary strain in a Latin poem, commencing,—

> "O corve, corvo rarior albido!"

In all the intercourse of private life, and all domestic and social relations, nothing could be more exemplary than the conduct and demeanour of Professor More. There was a gentleness of disposition which seemed to shrink from doing an unkind action, or saying a harsh word to any human being. He had that large-hearted feeling for mankind which could not withhold from others the mercy he expected for himself, and which would never deny encouragement to the most erring when making promises of amendment. I recollect his saying, with a charming simplicity of character, that he thought people were quite right to attend the lectures which Lolla Montes was delivering here at the time, as they proved that now she designed to turn over a new leaf, and to earn an honest livelihood! I have spoken of the pains which he took with his class. He was forbearing and patient with those who were idle or inconsiderate. When thoughtless or ungenerous members of the class would (as young men sometimes will) forget themselves, and take those liberties which are so unbecoming in the gentleman and the student, the kind-hearted teacher hardly gave indication that they were even noticed by him. He might be occasionally grieved or pained, but was never irritated. I have often thought it is good to have known such characters as John Schank More,—not, mark me, on account of great accomplishments, high genius, or profound learning, but because they put one in better humour with the world, and make one think better of human nature, as living illustrations of the great and pure principle of Christian love, and as exhibiting in their lives and dispositions a rare resemblance to the spirit of Him whose name we all bear. Let such men be held in honour by their cotemporaries, and let their survivors cherish their names with grateful remembrance, as true benefactors of their species, who have shown to the world, in characters which cannot be mistaken, the power and beauty of Christian gentleness.

Sir James Miles Riddell, Bart. of Strontian and Ardnamurchan, who died 28th September 1861, at the age of seventy-four, was long a Fellow of the Society, and at one time took much interest in its proceedings. He was beloved and esteemed by all his friends as a man of most amiable disposition, and honourable character, through life. Although Sir James could not be called a scientific man, in so far as special study of any branch of natural science was concerned, yet his name is associated, as a landed proprietor of Scotland, with an important mineralogical discovery. One of the earths was found on his property from which it is named, and as this mineral was first discovered by a Scotchman, and from the beginning has borne a Scottish name, I may perhaps be allowed to say a few words on the subject in passing. In 1787 some minerals were brought to Edinburgh by a dealer from Strontian, Sir James Riddell's property in Argyleshire. They were examined by Dr Hope, then the eminent Professor of Chemistry in the University. In 1791, Dr Hope announced, in a paper read to the Society, that in one of these minerals he had detected a new earth, and which he proposed to name Strontites, from the locality from whence it was received. It seems previously to have been confounded with barytes, and supposed to be some modification of that substance. The paper was more fully elaborated, and published in the "Society's Transactions" 1793. The German chemist, Klaproth, had also examined the Strontian mineral, and without any knowledge of Dr Hope's experiment, had also discovered in it the new earth, and called it "Strontion." According to our present nomenclature, the earth is called Strontia—the metal which forms the basis of the earth is Strontium, and was separated and exhibited by Sir Humphrey Davy. The native mineral from Strontian which produced the earth is called Strontianite, and is a carbonate of Strontia. It has been found also at Braundsdorf in Saxony, and elsewhere. There are other native minerals of which Strontia forms the basis, one called Celestine, so named from the beautiful blue tinge of its crystals. I have seen lovely specimens of Celestine from the Mountain Limestone quarries near Bristol. Finer specimens are, however, met with in the sulphur mines of Sicily, and still finer in the Strontian island in Lake Erie. When it was known that a new earth had been discovered in the Strontian district, the proprietor and all concerned were full of expectations of benefits which might accrue from the discovery of a substance of which they were supposed to possess a monopoly. But, alas ! no use has been found for it in the arts or manufactures—none at least of what may be called particularly beneficial. The only application has been in the form of nitrate of strontia, and which is made use of to produce that beautiful red light which is exhibited in fire works, and also in certain pantomimic and melodramatic effects in theatrical representations, which delight the children who attend, both young and old.

Dr James Robertson, was born in 1803, at Ardlaw, in the parish of Old Pitsligo. His father a farmer at Ardlaw, still survives at the advanced age of eighty-six. Dr Robertson completed his education at Marischal College, Aberdeen, and his first appointment in life was to the parochial school of his native place. He was soon after appointed head-master of Gordon's Hospital in Aberdeen. In 1832 he was appointed to the living of Ellon, in the gift of the Earl of Aberdeen, and was long familiarly known, as a powerful debater in the General Assembly, as Robertson of Ellon. In 1843 he was called to the Chair of Church History in the University of Edinburgh, and Secretaryship of the Bible Board, and which situations he held till his death, which took place unexpectedly, and after a very short illness, 2d December 1860. Dr Robertson was a man of acute mind and sound judgment, a fluent speaker, and of energy indomitable. I have always considered Dr Robertson an admirable specimen of the acute, clear-headed, business-like Scottish character. His pursuits and labours were all of a useful and practical character. The conduct of ecclesiastical affairs of the Church, general parochial management, the study of Church History for his lectures—everything connected with the poor and administration of the poor-laws, agricultural improvement of soils, and the currency question, were subjects closely and skilfully investigated by him. When parochial schoolmaster, he wrote a pamphlet "On the Currency," which attracted the attention of Lord Aberdeen, and which, in fact, led to his appointing him to the incumbency of the living of Ellon. There existed through their lives a friendship and sincere mutual regard, and these continued to their deaths, which happened within a few days of each other. Dr Robertson died on 2d December, Lord Aberdeen died on the 14th, 1860.

Dr Robertson was through life much interested in the currency question, and read a very elaborate paper on the subject, at Glasgow, during the meeting of the Association for the Advancement of Social Science, which was held in that city during last year. Some time before this I was much interested in hearing him brought out upon this question, on the occasion of his dining with me, when he met my dear friend, the late Alexander Blair of the Bank of Scotland, a man of highly cultivated mind, and of great attainments in theology, in classical and general literature—the first authority in Scotland upon banking, upon the currency, and indeed upon every subject connected with finance and the circulating medium. It was very amusing to hear the discussion between two such men—one all theory, the other bringing every theory to practice; the one arguing from the conclusions of an acute intellect, the other, from long and accurate experience of banking, and of everything belonging to it, and who well knew that every opinion in money matters, however ingeniously supported, must be brought to the test of experience in the working of it under all the circumstances of the social and monetary system.

The memory of Dr Robertson will ever be preserved in Scotland as connected with that great scheme of church extension with which his name is now always associated, and which owed so much of its success to his labours and his wisdom. The intention of the scheme is to create and endow above sixty new parishes in connection with the Established Church. He was mainly instrumental in raising, by immediate or by deferred payments, for this great object, a sum of nearly half a million; and on this portion of his life I am anxious to say a few words, and I do so not only because it called forth a marked feature of his own character, and because it indicated a special power of his own mind, but because I conceive it affords a most useful *general* lesson, and supplies an honourable example for all men who are engaged in practical work, and who have to aid in plans of advancing the interests of religion, of charity, or of any improvement in social life. I refer to his labours as secretary, or convener, in which he practically advanced the details of that object of which I have made mention. The scheme was most important, and in every way praiseworthy. It called upon the members of the Established Church to join in a great and well-organised scheme for church extension. I need not dwell upon the particular constitution of the plan, the special object it placed before the community, or the special means it had in view for attaining those objects. What I wish now mainly to notice is the manner in which our late member worked the machinery of the scheme,—the diligence he displayed—the cool, yet earnest decision with which that diligence was accompanied. I would refer to his clear and powerful statements of the case he advocated; I would point to his never-failing attendance at meetings throughout the country, his constant readiness to avail himself of all advantages, to meet all deficiencies, and to correct all mistakes. His labours never seemed to be at rest; his sagacity was never at fault. It was such qualities advanced into full action that, under the favour of God's approval, brought the scheme to its present condition of efficiency, and opened its prospect of ultimate success. What I would mark out and recommend for approval and imitation, are those very exertions by which the efficiency of the scheme was promoted. Dr Robertson was a man of business, and such men are wanted amongst us,—wanted because they are scarce, and wanted because they are valuable. In vain will you have men of learning, eloquence, or acuteness upon your committees in great associations for advancing good purposes: if you have not men of *business*, the schemes will fall to the ground, or languish and decay. *Experto crede.* I have some little experience of such matters myself. Committees meet and questions are discussed, and faults are found, and measures proposed and adopted, and a great deal of acuteness and eloquence are displayed,—sometimes, perhaps, a little temper and vituperation. The committee separate, the matter sleeps, and, except some one takes it up vigorously to work it out in detail, the committee, at next meeting, find matters much in the same position as they were when they last parted. Now, all this *intermediate* labour was supplied by Dr Robertson ; he set himself to the work,—he would not permit the matter to sleep,—he pushed forward the scheme,—and to the last moment of his being able to hold the plough, did not look back from his good work. He determined that his countrymen should support his scheme; and the call of the Roman poet to the Roman people in many ways typified the call of the Scottish divine to the Scottish landowner, or wealthy merchant, "Delicta majorum immeritus lues, *donec templa refeceris.*"

Such was Dr Robertson. A man of the best intellectual and active habits, who brought his understanding and his activity to bear successfully on a great and noble scheme of national benefit. He was cut off at a comparatively early age, at least whilst still capable of much useful labour; but he was followed to the grave with the respect and honour of all his countrymen, whatever were their political opinions, whatever were their religious creed.

One name only remains on our list of deceased members, that of Erskine Douglas Sandford, advocate, and Sheriff of the Stewartry of Kirkcudbright and County of Galloway. He was born in 1793. He was eldest son of Dr Daniel Sandford in the Scottish Episcopal Church, Bishop of Edinburgh. Bishop Sandford was from an old family of Shropshire. But he formed a Scottish connection by marriage. Erskine Sandford was born in Edinburgh. He had become completely in feeling and connections a Scotchman, and at one time was in good practice and high reputation as an advocate, and a writer upon law. It encroaches, perhaps, too much on the offices of private friendship for *me* to say much upon the character of this our late Fellow. But I may appeal to the *general* feeling that pervaded the circle of Edinburgh society when the unexpected intelligence came of his death; every testimony was given to his character, as a man and as a Christian, and every sympathy shown to his family in the loss which by his death they had sustained.

Gentlemen,—I have now accomplished, however imperfectly, the objects which I had before me in this Address,—viz., 1st, To notice the influence exercised generally by learned associations upon the advancement and extension of literature and natural science; and, 2d, To take a brief notice of certain members of the Royal Society of Edinburgh who have died since the opening of the late Session.

Nothing more forcibly brings before us the advancement of mankind in mental improvement and in mechanical refinement than the power which we possess of realising the past, and of storing up the discoveries and the disquisitions which have been made by those who have preceded us. Human knowledge seems now to be all recorded for the benefit of posterity. There is such a multiplication of books, and such economy in the production of books, as to make that knowledge available to all ranks of society. There is an arrangement and classification of books according to the subjects of which they treat which prevent libraries becoming a hopeless labyrinth—an overwhelming incubus. The achievements of able and original minds are preserved by those who have possessed kindred spirits with their own, and none of their labours need be lost,—nothing that they have accomplished need perish. I think our scientific societies have had a great and extensive influence in producing these results. That spirit of combination and companionship which has worked such numerous and permanent effects in all departments of human life, and which is an innate principle of human nature, has operated in combining men for objects which may be good or may be bad. Whilst we see with pain and grief the union of human beings accomplished for the express *purpose* of evil, and for injuring others in order to promote the advantage of those who unite, it is delightful to think how close, also, combinations may be made for the improvement of the species, for advancing knowledge, either exclusively in one of its departments, or generally in every department. Men combine together in associations for amusement, for recreation, or for gaiety. They combine together for purposes of pecuniary profit, to secure political ascendancy, or more refined educational benefits for their families. This spirit of combination has produced also many associations like our own; around the labours and the operations of these there has gathered an accumulated history of genius and discovery, which must be enduring as the human species itself. The highest place in our veneration and esteem is, no doubt, due to those sacred associations which are formed under a religious spirit of union, either for disseminating the Word of God in all the languages spoken by the numerous families of human beings throughout the world, or for promoting the spread of Christian knowledge, whether amongst the neglected outcasts of our home population, or amongst the heathen who have never heard a Saviour's name. But *next* to these we may venerate and esteem the associations which unite men for the cause of sound philosophy, and for advancing all branches of useful human learning, which draw men together for literary and scientific purposes, and which impart to them a common interest in the discovery and extension of truth. We cannot fail to perceive the merit of associations which thus unite men of very different habits and occupations in the encouragement of all those pursuits which, as long experience has now proved, tend to ennoble man's nature, and to elevate his sources of enjoyment.

REVIEWS AND NOTICES OF BOOKS.

Report of the Commissioners appointed to Inquire into the Condition and Management of Lights, Buoys, and Beacons, with Appendix. Presented to both Houses of Parliament by command of her Majesty. London, 1861.

Memorial of the Chamber of Commerce and Manufactures of Edinburgh (Incorporated, by Royal Charter) to the Board of Council for Trade, &c. 1861.

To a sea-girt and truly maritime country like ours, it is not easy to conceive anything more important than the efficiency of its lighthouse system. To promote this object, a Royal Commission was in 1858 appointed, consisting of Rear-Admiral Hamilton, Captain Ryder, R.N., Dr J. H. Gladstone, Duncan Dunbar, Esq., M.P., and Samuel R. Graves, Esq., who conjoined with them the Astronomer-Royal, to inquire into and report on the whole subject. The report of this Commission, which was laid before the last session of Parliament, gives a review of the lighthouses of nearly the whole world. The Commissioners personally inspected most of the lighthouses of the United Kingdom and France, and have been upwards of two years engaged in the inquiry. We were quite prepared to find that a country that has produced such works as Smeaton's Eddystone, Stevenson's Bell Rock, Walker's Bishop Rock, and Alan Stevenson's Skerryvore, should stand high in the annals of lighthouse engineering, and we were not mistaken. From what we can learn from a careful perusal of the report, the efficiency of our lighthouses, more especially those in Scotland, is not surpassed by those of any quarter of the world.

The lighthouses of the United Kingdom are, as our readers are no doubt aware, placed under the management of three separate Boards, namely, the English under the Trinity-House of London, the Scotch under the Commissioners of Northern Lights at Edinburgh, and the Irish under the Ballast Board at Dublin. The Merchant Shipping Act of 1854 enacted that the Commissioners of Northern Lighthouses and the Ballast Board should report to, and receive the sanction of the Trinity-House as regards the sites of all new lights, and that the whole three Boards should, in all matters regarding the selection of sites and expenditure of funds, report to, and secure the sanction of the Board of Trade. This divided responsibility seems to have led, in some cases, to much unnecessary correspondence; and the result of the Commissioners' recommendation is, that while commending, in some respects, the management of all the three Boards, but especially that of the Commissioners of Northern Lighthouses, they recommend the formation of a central Board, to be called the "Trinity Commissioners for Lights," to consist of four members resident in London, one in Edinburgh, and one in Dublin, and a seventh to be selected by Government, "with special reference to his scientific acquirements in these branches of knowledge which relate to coast illumination." To these, it is proposed to add, as *ex officio* members, "the Astronomer-Royal, the Hydrographer of the Admiralty, the Comptroller-General of the Coast-Guard, and one of the professional members of the Board of Trade."

In making this recommendation, it appears to us, that independently altogether of the injustice which it does to the Commissioners of Northern Lighthouses, the Royal Commissioners have allowed themselves to be actuated more by the general vague feeling that *centralisation* is the panacea for all evils, *fancied* or *real*, than by any positive objections to the existing lights, or by any conviction of the practicability of their own involved and cumbrous proposal for managing them. Before Government adopts such a recommendation, it would surely be wise to see whether the remedy which it proposes be applied in the right quarter, and whether all that is wanted in the shape of improvement cannot be attained by alterations on the constitution of some of the existing Boards. It appears to us self-evident from the report itself, that the Northern-Lighthouse Board has satisfactorily and efficiently discharged its duties, and that, had the Commission found the English and Irish as fully up to the mark as the Scotch admittedly are, they would have had nothing to recommend; and yet it is strangely enough proposed to supersede the Scotch Board.

Now, the question not unnaturally occurs, Would it not be more appropriate, as well as a more just course, to propose that the English and Irish Boards should adopt the Scotch system? In support of what we have now stated, we give the following quotations from the Report, in which the superiority of the Scottish Lights seems to us to be clearly demonstrated and admitted.

As regards the "Character of the Source of Light," the Commissioners say—"To the subject of the height of the flame, your Commissioners have given much consideration." . . . "The flame in English and Irish Lights is kept far too low." . . . "This fault was not found to exist in the lights under the Northern Commissioners, who make use of a mechanical pump-lamp, which burns, on an average, 794 gallons of oil annually, and produces good flames of about double the height of those in England or Ireland." . . . "From this it is evident, at a glance, that as the Scotch dioptric lights burn a larger amount of oil than the English or Irish, they are more expensive in that item; but in this particular, expense becomes a measure of efficiency." . . . .

Under the head of "Character of Apparatus by which the Light is Directed," it is stated—"There are two principal means by which it is sought to throw the light in the desired direction. The one is by silvered parabolic reflectors, and is called the 'Catoptric' system, the other is by lenses of peculiar construction, and is called the 'Dioptric' system. Sometimes the two systems are combined together, as in the ordinary 'Catadioptric,' and in Mr (Thomas) Stevenson's 'Holophotal' arrangement. The table already given (page 15) shows the proportion between the catoptric and dioptric lights at present existing in the three kingdoms. It will be seen that the principle of refraction is generally adopted in Scotland, while that of reflection still holds the numerical preponderance in England and Ireland." . . "As to the optical apparatus, the dioptric system,* invented and first employed in France, has been gradually adopted in our own country, and in Scotland some improvements have been made in it." . . "Few will doubt that a combination of the two" (dioptric and catoptric) "would often be the most efficient; and such combinations exist in all countries, but especially in Scotland."

On the subject of the "Quality Compared with Foreign Lights," the Commissioners say:—"The quality of British lights (speaking generally) is equal to the quality of lights in any part of the world." "The fixed catoptric lights of the British Isles," it is stated, "will not bear comparison with revolving lights on the same principle, or with the dioptric lights of France or Scotland."

---

* It may be interesting to our readers to see the conclusion to which the Commissioners have come as to the origin of the lenticular system, which has been the subject of some discussion in this country.

Under a head termed "General Authorities," the Commissioners say: "The Trinity House has consulted Professor Faraday, as its scientific adviser, since 1836; but it appears that he only gives his opinion or advice on such subjects as are submitted to him. The Northern Commissioners have had the great advantage of having associated with them the family of the Stevensons, who have given much attention to those departments of science which relate to lighthouse illumination."

"As a test of the degree of scientific knowledge exhibited by the different lighthouse authorities, your Commissioners asked for copies of the plans, specifications, &c., actually submitted to the manufacturers, in ordering the last two sets of lenticular apparatus of large size or peculiar form. The resulting correspondence is given in vol. i. p. 210, with an account of the different practice of the four principal lighthouse authorities, viz., the Board of Trade, the English, Scotch, and Irish Boards. From this it appears that, in Ireland, forms of tender are issued, 'setting forth the arc intended to be illuminated, the number of panels and zones required, and the apparatus shall be of the best quality, and fitted together correctly;' in England, printed forms and lithographed drawings of small size are furnished to the contractors; while in Scotland, large working drawings and minute directions are given by the engineers employed by the governing authority for the execution of apparatus specially designed by them for special localities.

"In the case of the English and Irish Boards, the governing body does not originate the design. In Scotland, a design is furnished by the governing body, and the manufacturer has only to execute the order given.

"The latter arrangement seems calculated to produce an advance in science." . . . . .

"Here, then, seems to be a defect in the system of management." . . . "When they employ men who have made these particular branches of knowledge their study, the result is good. The Commissioners of Northern Lighthouses have, in this respect, shown themselves considerably in advance of the Elder Brethren of the Trinity House, by employing an engineer who has studied lighthouse illumination, and claims to have invented or introduced many improvements into optical apparatus, to prepare specifications for scientific work. The result of the opposite course adopted by the Trinity House is shown in the defects observed at Godrevy, the Start, the North and South Foreland, Whitby, &c."

In the section headed "Efficiency and Economy of Government," the following statements appear:—

"Generally, to inspect the minor arrangements of one lighthouse in Scotland is equivalent to having seen them all; for the only variety seems to be in the illuminating apparatus, which in very many instances is specially designed for the locality, and has to be separately examined before it can be fully understood; while in England, the uniformity is rather to be found in the illuminating apparatus than the minor details of the service, which vary in different lighthouses. In Ireland, not only is there a great want of uniformity as to the minor details, but they seem to be very much overlooked and neglected, while the apparatus is about equal to that of the Trinity House."

"In Scotland, as in France, a drawing of the flame, as it ought to be when at its best, is framed and glazed, and hangs in every light-room; this is not to be found in England or Ireland.

"In Scotland alone a table of the time for lighting and extinguishing is hung up in the light-room. These times differ for every latitude, and are carefully calculated for each lighthouse in Scotland, and the result is, as before stated, a considerable economy.

"In Scotland, whistles are placed in every lantern, which communicate with the rooms below by tubes, in order to summon assistance, if required, and to avoid the necessity of the keeper in charge leaving his post until relieved. There are no communicating whistles in England, or Ireland, or in France."

. . . "In Scotland, the keepers go through a regular course of instruction and training as extra-keepers at lighthouse stations, where dioptric and catoptric apparatus exist, and have to pass an examination before they are intrusted with the care of a light. In England, a preliminary course of instruction is gone through at the Trinity Board's Establishment at Blackwall; and in Ireland there is no such system of instruction—certain questions only being put to the candidate on his presenting himself."

"All these points influence the *efficiency* of the lights; and there can be no doubt that of all the British lighthouses visited by your Commissioners, the Scotch are in the best state of general efficiency, the English next, and the Irish third; and the local authorities, with certain exceptions, range far below the general authorities."

The statement of the Commissioners, "that the quality of British lights (speaking generally) is equal to the quality of lights in any part of the world," coupled with the further statement that there can be no doubt that of all the British lighthouses the Scotch are the best, leads to the conclusion that the lighthouses under the Commissioners of Northern Lighthouses are, on the whole, better than any they had seen. This is confirmed by the Astronomer-Royal, Mr Airy, who, in his Report to the Commission on his examination of Girdleness, in Aberdeenshire, after having inspected the Lighthouses of France and England, says of Girdleness, "It is the best Lighthouse I have seen."

We beg to refer such of our readers as may wish to see further details, to the Report itself, which is a very voluminous one.

We cordially concur in the conclusions of the Chamber of Commerce of Edinburgh in their Memorial to the Board of Trade in reference to the Report quoted at the beginning of this article, which are in the following terms:—

"After careful consideration of the Report by the Commissioners, it humbly appears to the Chamber that the only conclusions which can be come to are:—

"1. That it would seriously injure the public service were any change agreed to which would abolish the present Board of Northern Lights, which, from its compound constitution, embracing at once high official rank and commercial experience, has brought the Northern Lighthouses to their present state of efficiency.

"2. That any conflict between the separate Boards, as at present, would be obviated by each Board being restricted to local management, subject to the immediate control of the Board of Trade.

'3. That the admittedly efficient system of management of the Scotch Lighthouses could, without any radical change, be easily and at once adopted by the existing Boards of Management in London and Dublin."

Medical Climatology; or, A Topographical and Meteorological Description of the Localities resorted to in Winter and Summer by Invalids of various Classes both at Home and Abroad. By R. E. SCORESBY-JACKSON, M.D., F.R.S.E. Churchhill: London, 1862. 8vo, pp. 509.

Climate is a subject of great interest and importance, whether we regard its bearing on the distribution of plants and animals, or on the wellbeing of the human race. The determination of the elements of climate is a matter of much difficulty. Light, heat, and electricity, moisture and dryness, the movements of the atmosphere, and its weight and composition, the nature of the soil, the relation between land and water, the influence of the sea, the elevation above its level, the flat or mountainous character of a country, the vegetation, especially the forests, and a multitude of other data, require to be taken into account before we can form proper conclusions as to climate.

Dr Jackson defines climate as the sum of all those physical forces which, by their operation upon the constitutions of organised beings, prohibit their permanent migration from one region of the earth's surface to another. He then proceeds to say—"But *man*, it may be said, in objection to such an interpretation of the word—man, at all events, is cosmopolite; he can go everywhere and live anywhere! It is true that the erect and intellectual being who received at the hands of his Maker dominion over all precreated subjects, and to whose necessities all meaner creatures subserve, is endowed with a constitution of such a character as enables him to violate the laws of climate with apparent impunity, and to journey hither and thither in his military, commercial, or scientific capacity, according to the impulse of his will. We know that the inhabitants of temperate climates have passed prolonged seasons in foreign countries whose annual mean temperature is widely different from that of their native land. What better proof can be adduced of the perfect possibility of doing so than the facts that our own brave soldiers have fought and conquered beneath a broiling Indian sun, whilst our gallant sailors have borne unscathed the rigour of an Arctic winter. Nevertheless, the grand fundamental law remains untouched. The Great First Cause has distributed His creatures according to the counsel of His will; He has supplied them severally with constitutions, food, raiment, and even medicines suitable to the regions in which they are placed; and the order of His original design is yet maintained by 'fire and hail, snow and vapours; stormy wind fulfilling His word.' Man may make temporary exceptions; but nature knows no inconsistencies. Lions are not found on icebergs, nor do reindeer graze in the region of palms. Esquimaux would perish where negroes revel in the exuberance of nature's gifts. Palms, bananas, and tree-ferns, would be immediately disorganised if placed by the side of the chubby little moss that braves a climate of eternal snows. Nor can the inhabitant of temperate regions, with all his superior advantages, ultimately abrogate the laws of climate. We have no proof of, but, on the other hand, much to disprove, the possibility of even his *permanent* migration from one region to another. History has declared beyond dispute, that the races of different nations cannot by intermarriage propagate a distinct variety through many generations; and, if it be not yet a demonstrable fact, it is, at least, a high probability, that *all* who leave their native soil to reside in foreign climates would ultimately *die out* were this not prevented by the return of their offspring to spend a portion of their lives in the mother country, or through the transfusion of new blood into the veins of their descendants by intermarriage with immigrants fresh from the parent stock. It is not our purpose to argue this point. The question we are to deal with is one touching a *temporary* and not a *permanent* residence in a foreign land. We are to regard climate in its aspect of remedial agent,—as the handmaid of medicine. We are to ascertain to what extent it may be employed to the advantage of one whose precarious health demands a residence in a country where meteorological vicissitudes are either at a minimum, or, at all events, are likely to exercise an influence upon his constitution different from that of his usual habitation.

In the meantime, it is worth considering, briefly, what the circumstances are which, individually and collectively, determine the climate of a country. It will be sufficient to remark concerning our planet, as a whole, that it is spherical in form, having a superficial area of one hundred and forty-eight millions and a half square miles, one-fourth only of which constitutes the dry land, the remaining three-fourths being occupied by water; that it is completely surrounded by a ponderous and mobile fluid known as the atmosphere; and that it is intimately related with, although at a distance of ninety-five millions of miles from, the great luminous centre of the solar system. And we shall find, that the diversity of climate which exists in different regions of the globe depends simply upon the variety of relationship subsisting between these coefficients."

He then considers the following elements of climate,—distance from the equator, elevation, relative position of sea and land, oceanic currents, aspect or exposure of a locality, physical and chemical properties of the soil, state of cultivation, the atmosphere, electricity and ozone, insolation or intensity of solar light, hydro-meteors, rain, dew, prevalent winds, and temperature.

The influence of change of climate on certain kinds of diseases is now generally acknowledged by medical men. Sir James Clark is one of the most prominent writers on this important subject, and his work on climate has led the way in the investigation of the remedial effects of change of air. Dr Jackson tells us that his work is the result of six years' preparation, and that it is grounded partly on personal experience of the sanative influence of the principal winter resorts in the south of Europe and north of Africa. He has spent also three summers amongst the French, Swiss, and German Spas; and he has read every work on climate and cognate subjects which he could procure.

" Medical Climatology is every day taking a stronger hold upon the minds, not only of medical men, but of the general public. Side by side with sanitary science it is developing into a subject of the utmost importance. Preventive Medicine is at length taking up a position commensurate with its value, and it is fostered by the remarkable facilities which now attend the traveller in his wanderings over every part of the world. People look forward to the season when they 'go away' to have their mental and physical condition reinvigorated, after nine or ten months of constant toil. Invalids, too—real invalids—travel much more than in former times, when the wealthy alone could enjoy the privilege. An important question arises out of this widely developed system of migration. 'Where must I go to?' is a form of interrogation which every medical practitioner should be prepared to answer without hesitation. It is a momentous question, however, and demands a careful and accurate reply. In order to become acquainted with the predominating features of particular climates, medical men must either study every work on the subject as it appears, which I venture to believe few have time to do, or they must be supplied with a work containing the requisite information in a condensed and readily consultable form. Such a book, I trust, the reader will find the one now presented to him. It is written in a spirit of impartiality, and with one only end in view, that of furthering the convenience and interests of my professional brethren. I have no particular climate to eulogise above its fellows, no personal interests to serve. I have written it, as I have said, for the accommodation of professional men, and I do not intend it, except, perhaps, in rare instances, to be used as a *guide* by the invalid; he will, if he rightly understands his own welfare, be subject only to his own medical adviser. This principle I have endeavoured to inculcate upon non-professional readers at every opportunity throughout the work; and it has been simply with a view of avoiding circumlocution, that I have seemed in many instances to address my remarks immediately to the invalid himself."

The author, who is an accomplished medical man, enters fully into the subject of Hygienics, and points out the circumstances to be attended to in the preservation of health, as well as in its restoration by change of climate. As to the choice of a residence, he remarks,—"A fair prospect and a pure atmosphere are the points of importance,—'*Qualis aër, talis spiritus; et cujusmodi spiritus, humores*,'—the former regales the mind, the latter refreshes the body. Plato recommends that no traveller should lodge in a city that is not governed by laws, and that has not a quick stream flowing near it. The invalid will not, however, always meet with those sanitary regulations which are most conducive to health; but he may, at all events, follow the spirit, if not the letter, of the sage's advice, by adopting a residence in such a locality as is least crowded and somewhat elevated, so as to avoid a vitiated atmosphere and the dampness arising from stagnant waters. There is one circumstance particularly to be remembered,—namely, that in removing to what is understood to be a mild winter climate, at least in southern countries, the traveller will meet with houses that are built not so much with a view of being warm in winter as of being cool in summer; and hence, especially in Italy, they are constructed in such a manner that the sun's rays can rarely, if ever, gain access to the interior of their apartments, which are usually lighted from an inner court. Such houses are cold and gloomy in winter, and should give place in the invalid's selection to a warmer and more cheerful edifice. The most desirable aspect for an invalid's residence is that in which the warmth and light of the sun are enjoyed during the longest period on a winter day, and one which, at the same time, is protected from the influence of noxious winds. Dampness, the especial bane of all delicate constitutions, should be guarded against by choosing a somewhat elevated situation upon an inclined surface of sandy or gravelly construction; and, with the same object in view, ponds, lakes and marshes should be avoided. If, however, in spite of these precautions, there be the least suspicion of dampness in the walls of the house, the upper apartments alone should be occupied; and in this manner both financial and sanitary economy may be combined with advantage, for the upper storeys of houses are not only usually the cheaper, but also the more healthy. In addition to other requisites, it is essential that the house have near it a fitting place for out-door exercise. Unfortunately, however, it often happens that the invalid finds himself a martyr at the shrine of fashion; for in almost all places of winter resort the hotels and lodging-houses, which alone have suitable accommodation, are crowded together, and that, too, not unfrequently in an ill-chosen locality. But there is something to be desired beyond the external circumstances of an invalid's dwelling. The view from the windows, as previously mentioned, should be cheerful and engaging; and, still more, the internal arrangements should savour of comfort. The rooms should be lofty and airy; there should be, if possible, a fire-place capable of consuming *coal;* for that is a more wholesome fuel than wood, and at night the apartments should be lighted with candles, for they are less deleterious than gas. Close stoves, hot air, or hot-water pipes, and every variety of *chauffage*, excepting that effected by means of an open grate, is decidedly bad. An uninterrupted ventilation is above all things essential. Without very great attention to this, an invalid, without the least suspicion of it, may occasionally be detected breathing an unwholesome and poisonous atmosphere. And, finally, the in-door temperature should never be made to exceed that of the external air when the latter is at, or above, 60° of Fahrenheit's scale; nor should it be allowed a greater range than 8° or 10° below that point." The subjects of food, baths, sea-bathing, clothing, exercise and sleep, and mineral waters are noticed.

In Chapter IV. a sketch is given of the diseases in which change of climate is to be recommended as a remedial agent, and of the particular localities suited to different ailments. Then follows an account of the various places to which invalids resort, including those in Algeria, Australia, Tasmania and New Zealand, Canada, New Brunswick, Nova Scotia and Newfoundland, Cape of Good Hope, Natal, France, Germany, Belgium, Switzerland, Great Britain, Ireland and the Channel Islands, Italy, Madeira, Azores, Canaries, Spain, Portugal, Gibraltar, Malta, Ionian Islands, Egypt, and West Indian Islands. The work has been drawn up with great care, and contains a large amount of valuable information. The climates of the different countries are well recorded, and the advantages of different localities clearly stated. The author has added a chart of medical climatology, showing the mean temperature of the principal places on the globe. This chart has been adapted to the work by Mr A. Keith Johnston, the well-known writer on physical geography. We cordially recommend the work, as bringing our information on Climate as a remedial agent up to the present day, and as supplying an excellent manual both for medical men and patients. We would suggest that in a future edition the author should insert a general table of contents, which would add to its value.

Footnotes from the Page of Nature; or, the First Forms of Vegetation. By the Rev. HUGH MACMILLAN. Cambridge, 1861. Macmillan and Co. 12mo, pp. 294.

This is a pleasing and instructive account of what are called the lowest classes of plants—mosses, lichens, fresh-water algæ, and fungi. It is written by one who is enthusiastically fond of botany, and who, while discharging faithfully the higher duties of a clergyman in a Highland parish, does not neglect the prosecution of science. Well would it be for all ministers if they paid attention to natural history in some of its departments. It would supply many illustrations of Scripture, and would lead them to contemplate God in his wondrous works as well as in his Word. To a country clergyman the study of botany is specially attractive. It is a science which he can prosecute at all times, and it furnishes healthful and instructive occupation in his varied perambulations. The attention of the Churches has been called to this subject ; and the proposal to require that every Master of Arts in the Scottish Universities shall profess at least one branch of science, such as chemistry, zoology, botany, or geology, will, if carried out, be productive of the best effects.

In the little volume before us Mr Macmillan directs attention to some of the most minute and often despised organisms ; and he points out the beauty of the structure of cryptogamic plants, especially when viewed by the microscope, the interesting nature of their functions, and the important uses to which they are subservient. He shows that the study of these plants has a tendency to elevate and enlarge our conception of nature, and that they can be observed and collected without interruption throughout the whole year,—under the cloudy sky of December and in the sunshine of June. They are no summer friends. As Ruskin has beautifully observed, "Unfading as motionless, the worm frets them not, and the autumn wastes not. Strong in lowliness, they neither blanch in heat, nor pine in frost. To them, slow-fingered, constant-hearted, is intrusted the dark eternal tapestries of the hills; to them, slow-pencilled, iris-dyed, the tender framing of their endless imagery. Sharing the stillness of the unimpassioned rock, they share also its endurance; and while the winds of departing spring scatter the white hawthorn blossoms like drifted snow, and summer duns in the parched meadow the drooping of its cowslip-gold, far above among the mountains, the silver lichen-spots rest, starlike, on the stone, and the gathering orange-stain upon the edge of yonder western peak reflects the sunsets of a thousand years."

The work is illustrated by a coloured plate, and by numerous woodcuts. It is written in an easy popular style. It is not, however, a superficial production. It conveys much correct and valuable botanical information, and is the production of one who knows as well as loves science, and who looks upon nature in its true position as regards revelation. As a specimen of the descriptive power of the author, we quote the following notice of fungi:—

"Having thus given a somewhat lengthened and detailed account of the structure, properties, uses, and other peculiarities of this curious and interesting tribe of plants, it may be proper, in conclusion, to glance at the place which they occupy as æsthetic objects in this fair creation. The careful observer will find the universal spirit of beauty sometimes as aptly and richly represented in these productions of corruption and decay, as in the more admired products of the vegetable kingdom. The very commonest fungi, which grow in the darkest and dreariest spots, are invested with a beauty not absolutely essential to the part which they perform in the operations of nature, or to the efficiency of the organs, whether of absorption or reproduction, with which they are furnished. The fructification of one is a most graceful umbrella, adorned with varied, delicately-shaded hues, and with exquisitely carved veils, fringes, and gills; that of another presents the most beautifully sculptured ivory pores and sinuosities, or richly-coloured tubes or spikes. One species looks like a ruby cup; another is embossed with stars; while the leaves and the grasses of the woods and fields often form niduses for some of the loveliest and strangest forms which our Creator has scattered over the earth with lavish hand, to delight the intelligent and observant eye. There is not in nature a more picturesque object to the painter, or a more interesting study to the botanist, than the old decaying stump of a tree in some lonely unvisited haunt of a shady ancestral wood, where the soil, enriched by the organic contributions of centuries, is bursting into life through every crevice and in every inch. Such a stump, as Wordsworth beautifully says of the mountain, is 'familiar with forgotten years.' It is long since the tall massive oak which it supported has been removed by the axe, leaving a gap which the encroaching trees around strive in vain to conceal; and nature has kindly smoothed away the traces of man's harsh treatment, and brought it back to perish on its own bosom. Every sunbeam and rain-drop that descended upon it, while crumbling it more, increased its picturesqueness; and while depriving it of its own life, helped to develop upon it other forms of life lower in the scale, until now, it not only adds to the air of antique mystery which pervades the scene, but peoples it with all the fantastic tenantry of Shakspere's fairy land. In one corner may be observed a cluster of elegant pearl-like mushrooms, wee elfin-looking things with long black stalks, and white wheel-like heads; in another, the corky leaves of a Thelephora closely pressed to the wood, with shell-like patterns, and colours as beautifully and dimly shaded on its surface as in a misty rainbow; here the soft, viscid, flesh-like knobs of the *Tremella sarcoides*, resembling tiny teats,—or the wrinkled, quaking, gelatinous mass of the witches' butter, looking more like a frothy exudation from the stump itself than a plant; there a Spathularia protruded from a wide, mouth-like gap, like an old woman's tongue, frightening away every young rustic, full of the adventures and transformations of the seven champions of Christendom, from plucking it off, lest the owner, a metamorphosed witch perhaps, should return in proper person to demand her unruly member, and inflict a proportionate punishment; in the middle of the squared top, covered with the minute scurf-like germs of unknown plants, are clustered the beautiful round vermillion balls of the Lycogala, or wolf's milk, which, when bruised, exude a dark, grumous liquor like clotted blood; while springing from the crevices of the bark, near the ground, the *Agaricus necator* overtops the rest, with its zoned and olive-coloured cap and dusky stem, distilling, when broken or injured, a blood-like fluid, as though it were a sensitive creature, thus reminding one of Dante's terrific picture of the living forest in the infernal regions. All these, with a score of other curious microscopic plants, hiding themselves from the superficial observer, but revealing themselves openly to a close and minute scrutiny—cup-lichens and trailing green mosses, and slimy green dust-like confervæ, surrounded perhaps with a border of dock-leaves, or a fringe of palmy ferns,—invest the aged stump with a nameless charm in the estimation of all true lovers of the picturesque. And returning from the woods and the fields to the retirement of our own homes, we find that there are forms and living things to be seen there as beautiful, interesting, and suggestive of curious thought, as any we have seen in the wider field of nature out of doors. If we examine under the microscope the green or grey covering which spreads over damp walls, or envelopes a stale piece of bread or fruit in a cupboard, or creams over the surface of preserves, what a wonderful scene of beauty suddenly unfolds itself like a miracle to our view! Thousands of plumy trees and feathery fern-like plants rear themselves up in every conceivable attitude, and all so delicate and transparent that the minute seeds are seen lodged in the interior of their stems; luxuriant forests draperied with pendent parasites, and milk-white mosses enveloping the ground, and clothing old, rotten-looking stumps with beauty, all busy in the fulfilment of their offices, lengthening and swelling, and falling and scattering their minute seeds in little white clouds up and down the surrounding air. He who is privileged to feast his eyes on such a beautiful and instructive spectacle as this, must deeply feel, with the eloquent Ruskin, that 'the Spirit of God works everywhere alike, covering all lonely places with an equal glory, using the same pencil, and outpouring the same splendour in the obscurest nooks, in spots foolishly deemed waste, and amongst the simplest and humblest organisms, as well as in the star-strewn spaces of heaven, and amongst the capable witnesses of His working.'"

Scripture and Science not at Variance; with Remarks on the Historical Character, Plenary Inspiration, and Surpassing Importance of the Earlier Chapters of Genesis. By JOHN H. PRATT, M.A., Archdeacon of Calcutta. 4th Edition. London: Thomas Hatchard. 1861. 8vo, pp. 158.

It has often been said that the discoveries of science are at variance with the statements of Scripture, and it is sometimes difficult for those who believe in the inspiration of the sacred volume to repel the charge made against it by sceptical men of science. The object of Archdeacon Pratt's work is to present such persons with a reply in a concise and portable form. It points out the difficulties to be met with and the objections to be removed, and tends to strengthen the faith of those who believe the Word of God. The author gives instances in which Scripture and science were supposed to be antagonistic, but which were cleared up by subsequent discoveries. He then enters on an examination of the earlier part of the Book of Genesis, and concludes that no new discoveries, however startling they may appear at first, need disturb our belief in the plenary inspiration of the sacred volume, or damp our ardour in the pursuit of science. The vexed questions in regard to the six days of creation, the origin of man and of species, of death before Adam, the nature of the Deluge, the origin of languages, are ably handled. Many apparent discrepancies are explained, and several false theories are exposed. The author writes as a man of science, and at the same time a believer in the Bible; and he supports his views by able and judicious arguments. "The *hasty* and *immature* deductions of Science may sometimes stand in opposition to Scripture; but their *settled* results, in which the body of philosophers agree, often confirm and illustrate the statements of the Inspired Volume. Let us then hold firm our grasp upon this truth, that the Scriptures are the infallible Word of God, true in every statement they contain, although the interpretation sometimes demands more knowledge than we at present possess; but let us at the same time remember, that there is no ground whatever for ceasing to pursue science, in all its branches, with an ardent and fearless mind. God's Word and Works never have contradicted each other, and never can do so. The progress of science is inevitable, and it is the glory of man's intellectual endowments. It is the setting forth of the greatness and wisdom of the Creator in His works. Let us therefore push on investigations to the utmost with untiring energy. We have nothing to fear. The greatest perplexities may at any time surround us; but both reason and experience have armed us with arguments which assure us that all will be right. Whatever happens, let our persuasion always be avowed, that Scripture cannot err. Let us be content rather to remain puzzled, than to abandon, or even question, a truth which stands upon so immovable a basis."

God's Two Books; or, Nature and the Bible have one Author. By THOMAS A. G. BALFOUR, M.D. 12mo. London. 1861. James Nisbet and Co. Pp. 132.

The present work is intended to be introductory to one which the author has published on "The Typical Character of Nature; or, All Nature a Divine Symbol." He endeavours to bring forward, in a concise form, some of the arguments in support of the view that Nature and the Bible are two revelations from the same Divine Author,—that the book of nature and the book of grace exhibit a striking similarity in their language, and that both are constructed on the same general plan. He points out that Nature and the Bible are superhuman, that they are inexhaustible, that all in them is regulated by law, that they admit of generalisation in virtue of their constitution, that no systematic arrangement exists in either of them, that both allow vicarious action, that they acknowledge special Divine interposition, that in both there is a law of progression, that simplicity characterises them as well as economy co-existing with abundance, that the same agents in universal destruction are employed in both, that the results obtained are by seemingly disproportionate agency, that in both we find opposite effects resulting from the same agency according as we treat it, that secret and invisible agency is employed in both, and that in Nature and the Bible a unity of purpose is exhibited. In all these respects the two revelations are compared. In speaking of substitution and vicarious action in accordance with law in both Nature and the Bible, the author says: "The doctrine of substitution in chemistry is now a universally admitted fact. Here we find one element replacing another, while still the general character of the compound is maintained, as in the case of iodine, bromine, or cyanogen being substituted for carbon. Again, in the case of ammonia (NH_3), we have one or more equivalents of the hydrogen replaced by one or more equivalents of methyle, æthyle, propyle, butyle, &c., and yet the type and chemical relations of NH_3 are retained. Laurent, indeed, has adopted a nomenclature, by means of which, if we know the composition of the original substance, we can at once tell that of the new one obtained by substitution. It consists in employing the different vowels for the different proportions of the vicarious element. Again, in the case of ether ($C_4 H_5 O$) we have the substitution of chlorine for the one atom of oxygen and for each of the five atoms of hydrogen, in which case the replacement is complete, and we have all the intermediate gradations till we reach $C_4 Cl_6$. The alums also afford a good example of the same doctrine. . . . . We find also in the constitution of some plants that, when they grow near the sea, soda may replace potash. The whole class of types which occurs in the structure of vegetables and animals affords plain evidence that the same law holds good here also. But in chemistry we have a much more close resemblance to the moral substitution; for we find that it is only among congeners that this permission is granted. . . . . Vicarious action, then, is an acknowledged fact in nature. It produces, as it were, 'the balance of power' among the different organs, and secures the safety and well-being of the individual; and as God acts on this principle in the physical creation, so in the moral it is found holding a prominent place, for it is the grand central point of all Revelation. Every promise had reference to this; every bleeding sacrifice proclaimed significantly the same great truth; the scapegoat, led to the barren wilderness with confessed sins of the people on its head, teaches the same all-important lesson; the priesthood itself is in the room of the first-born, while it also points to the High-Priest of our profession."

The work indicates the importance of placing science and history side by side with the Bible, and of studying their mutual bearings and harmonies. In these days, when a tendency has been shown by men such as the writers of the "Essays and Reviews" to subvert entirely the Divine authority of the Sacred Volume, it is well to have such a work as the present, which brings out the common Divine origin of the twofold revelation in Nature and in the Scriptures.

A Manual of the Sub-Kingdom Cœlenterata. By JOSEPH REAY GREENE, B.A., Professor of Natural History in the Queen's College, Cork. London, 1861. Longman & Co. 12mo, pp. 271.

The author of this work is already favourably known by his "Manual of Protozoa," with a general introduction on the Principles of Zoology—which is an excellent text-book for students. The present volume is an abridgment of a larger work, which the author hopes ere long to publish. The Cœlenterata include such animals as the Hydra, Sertularia, Medusa. Actinia, and Zoophyte. They are all furnished with an alimentary canal, freely communicating with the general or somatic cavity. The substance of the body consists essentially of two separate layers; an outer, or ectoderm, and an inner, or endoderm. These two membranes, but especially the former, are in general provided with cilia. In the integument of these organisms we constantly meet with peculiar thread-cells, which, when they come into contact with the human skin, frequently produce disagreeable stinging sensations. The sub-kingdom is divided into two orders:—1. *Hydrozoa*, in which the wall of the digestive sac is not separated from that of the somatic cavity, and the reproductive organs are external; 2. *Actinozoa*, in which the wall of the digestive sac is separated from that of the somatic cavity by an intervening space, subdivided into chambers by a series of vertical partitions, in the faces of which the reproductive organs are developed. The author gives the morphology, physiology, classification, and distribution as regards space and time, of the animals included in these two orders. The facts are stated in a clear and interesting manner, and are illustrated by numerous excellent woodcuts. The author has given the most recent observations in regard to the anatomy and physiology of the animals, and has produced a manual of great value to the student of zoology, to whom these lower types of animals must ever present attractive subjects for observation. Physiology is indebted in no small degree for its progress to the labours of naturalists who have made researches into the functions of these animals, and we do not know any department of natural history more deserving of attention. Much has been done of late years in the illustration of the various divisions of the Cœlenterata by Forbes, Allman, Huxley, Hincks, Busk, Strethill Wright, Gosse, Agassiz, Sars, Siebold, Steenstrup, Müller, Milne-Edwards, Gegenbaur, Leuckart, and others. We have much pleasure in recommending Mr Greene's work as an excellent epitome of all that has been done by these authors. There is a valuable bibliography appended, along with a series of questions which are well calculated to test the student in regard to his knowledge of the subject.

PROCEEDINGS OF SOCIETIES.

Royal Society of Edinburgh.

Monday, 2d December 1861.

The Very Reverend DEAN RAMSAY, V.P., delivered an Opening Address, which will be found at page 79 of this Journal.

Monday, 16th December 1861.

The following resolution was unanimously adopted :—

That out of respect to the memory of H.R.H. the Prince-Consort, and in consideration of the heavy affliction which has befallen Her Majesty and the nation at large, this Society do now adjourn till Monday 6th January 1862.

Botanical Society of Edinburgh.

Thursday, 14th November 1861.—Dr W. H. LOWE, the President, delivered an Opening Address.

The following communications were read :—

1. *Extracts from Letters written during a Voyage to Alexandria.* By Dr HUGH CLEGHORN. Communicated by Professor BALFOUR.

"*Off Algiers, steamer Indus, Sept.* 23, 1861.

"Between Ushant and Cape Finisterre our vessel passed through troubled waters—the equinoctial disturbances were punctual, and we are a full day behind time. During the last three days I have scanned with a telescope parts of the shores of Portugal, Spain, and Africa, which are new to me, and I shall introduce a few notes from my diary as to sights in Gibraltar and Malta which may seem likely to interest you. The coast of Portugal had a very parched appearance, and did not look inviting to botanists. On the Rock of Lisbon we saw the large windmills and white convents mentioned by Dr Hooker in his botanical notes (*Kew Miscellany*, May 1848). There were a few traces of vegetation on the cliffs, which I imagined to consist of olive bushes and cork oaks. A naval paymaster, who has visited Cintra, told me that these trees grow larger in the valleys over the first range of hills. On the 26th we sailed into the Straits of Gibraltar, and enjoyed a splendid view of the Atlas Mountains in Africa, and of Sierra Nevada in Spain. There are some patches of recent snow upon the latter, showing that winter is not far off. We landed for 1s. each at the Old Mole. Above and between the apertures of the parallel galleries of this remarkable fortress caper bushes were seen hanging. The stupendous rock was otherwise scorched and bare. Armstrong guns are being added to strengthen the defences. The fruit-market lies close to the quay, and outside the drawbridge; it is fairly supplied with the following varieties :—Quinces, peaches, apples, pomegranates, grapes, olives, Spanish chestnuts, walnuts, filberts, stone pine seeds, Castile melons, &c. About 4 lb. of grapes and several pomegranates, in a plaited grass basket of Esparto (*Lygeum Spartum*, L.), are sold for 1s.; if homeward bound, I would have brought a basket for the Museum. We walked along the main street towards the Almeida or public pleasure-grounds. Passing the Post-Office and Library (a very good collection), and entering into an old Roman Catholic church, full of antique carving, pictures, and relics, we passed sentries, magazines, and barracks. On the parade-ground were soldiers of three of H.M.'s infantry regiments and many artillery. The glare of the sun was broken by the shade of a double row of *Phytolacca dioica*, which is planted in avenues along the public promenades. The foliage is dense and umbrageous, resembling *Ficus Tsiela*, the trunk short and stout like that of *Adansonia*. In the public gardens we observed *Aloe*, *Agave*, *Opuntia*, *Chamærops*, *Ricinus*, *Melianthus* (from South Africa). There are several fragrant Labiate plants and shrubby *Acanthaceæ*, *Geranium* (several), *Genista* (several) —*Sedum* covering the rocks. Of trees, the most striking are *Olea*, *Tamarix*, *Pinus*, *Thuja*, and *Acacia lophantha* (from South Australia). It is always interesting to watch the introduction of plants at such places as Aden and Gibraltar. In the crevices of the rocks, the large bulbs of *Scilla maritima* were impacted, throwing up beautiful scapes of flowers. Almost all the other plants were in fruit—this being the close of the hot weather. I secured some Spanish broom seeds for the Nilgiris, and Castile melons for the Madras Gardens. By moonlight the view was very fine—the town brilliantly lighted up with gas, the great rock towering up 1000 feet behind, and on the opposite side the African mountains being seen in outline. Dr Sutherland, Inspector of Hospitals, who was sent to the Crimea on special duty, joined us here, with Captain Douglas Galton, Royal Engineers; they are now reporting on the barracks and fortifications of the Mediterranean stations.

"After leaving Gibraltar we coasted along the province of Malaga, and afterwards sighted Algiers, which appears to be strongly fortified—there are lines of white houses belonging to French residents. I much wished to have landed and seen the gardens alluded to in Giles Munby's "*Flore d'Algerie.*" There is occasional steam communication between Malta and Algiers.

"30th.—Tunis visible at 8 A.M. after passing the uninhabited islands of Zembra and Zembratta, and another rocky one (Pentalaria), which is said to have been the penal settlement to which King Bomba exiled troublesome subjects. We could see the prison and the terraced vineyards. The population is very depraved. I had nearly forgotten to mention that of three Wardian cases entrusted to me from Kew, one for Thwaites was much broken in the Bay of Biscay, but subsequently repaired. I keep a glass case containing Cinchona plants in my cabin, and trust that they may reach in safety. You know, perhaps, that Dr T. Anderson has been ordered on a special mission to Java connected with Cinchona culture, which will afford him great opportunities of exploring the Dutch possessions in India."

"*Shepherd's Hotel, Cairo, 7th October* 1861.

"Immediately after arrival at Alexandria at daylight on the 5th, we received the astounding intelligence that the Nile had risen to an unusual height two days previously, overflowing the embankments, causing great destruction of life and property, and carrying away many miles of the railway between Alexandria and Cairo. It was ten hours before we received intimation as to future progress, during which we went to look at the riches of an Eastern bazaar, and afterwards to see the lions of that remarkable city—Pompey's Pillar, Cleopatra's Needle, and the Mahmoudi Canal, upon which the Pasha's gardens and the merchants' houses are situated. There was nothing very interesting in the latter, which is thoroughly Oriental. There were great masses of showy flowers—*Hibiscus*, *Oleander*, and *Lantana*; the inner edging generally consisted of rosemary. On the banks of the canal, which in the evening were crowded with carriages, and seemed to be the fashionable mall or course of the inhabitants, the characteristic plants were date palms in full fruit, tamarisk and cypress trees, and in the water *Papyrus* and *Saccharum*. After a late *table d'hôte*, we were despatched in the old desert vans to the railway station, where we travelled twenty miles, and were then put on board a small Nile steamer. We received special injunctions to carry nothing heavier than a carpet bag, but I was determined to carry the Cinchona glass case which was given to me at Kew, and have been able to bring it hitherto, but it has been for the last two days a source of continual anxiety by night and by day, and has been carried on through various trans-shipments with much difficulty. As Indian travellers do not now-a-days voyage on the Nile, this has been a remarkable incident in our wanderings. The whole country was flooded often as far as we could see—the usual landmarks for steering were submerged, and here and there we noticed the tops of trees in passing: while near *Kafir Zayat* we saw part of a railway engine and several carriages standing out of the water. On little islands and small raised embankments were long lines of villagers, with their camels, buffaloes, and sheep, and piles of furniture and goods to the water edge. I have been inquiring of the officials here as to the real state of matters, and am informed that the Nile rose 4½ feet above the usual average. The origin of the catastrophe is said to be the abolition of the establishment for watching the embankments, and whose duty it was to attend to the sluices, and repair any breach without delay. This evening the river is said to have subsided forty inches, so that it is not now more than a foot above the usual height at this season. The great question now is, to obtain an immediate and abundant supply of seed for the next crop; urgent applications have been made to the Pasha, but no reply has as yet been received. The *barrage* of the Nile, which cost two millions of money, and spoiled the navigation of the river, was our greatest obstacle; the current rushing through was prodigious, and the difficulty of encountering it was not small; the steering not being steady, the paddle-wheels touched the banks, and were slightly damaged. Our merciful preservation amid these strange and perilous scenes calls for the strongest expression of our gratitude. I had opportunity of examining in every tumbler of water the rich deposit of the Nile, which is even more abundant than that of the Ganges in the Delta. From conversation in the market-place, I fear that much Egyptian cotton has been destroyed as it was ripening. The public funds have been affected, and the cost of restoring the railway will be very great. The Pasha himself was visible, walking along the famous bridge built by G. Stephenson, surveying the effect of the inundations; we saw him leaving his state barge, which was towed by a small river-steamer, built in Glasgow. I have seen great floods in India, but generally the plains were soaked with rain, which caused the flood; here a vast extent of dry, parched land was inundated with fluid mud—the very edge of the river being hot sand or baked soil of brick-like hardness. The rain evidently falls on the mountains far distant in the interior of Africa."

2. *Measurements of Trees at Dryburgh Abbey; and Caver's Carre, Roxburghshire.*—By Dr John Alex. Smith.

(1.) *Dryburgh, September* 1861.

	Circum.	
1 An old yew tree taken at 4 feet from the ground.	10 ft.	6 in.
2. A cedar of Lebanon near the Abbey, taken at same height	6	4
3. A horse-chestnut near the house	10	4
4. A beech near the offices, at the damside .	13	6

5. An old cedar of Lebanon, near the house and close by the dam	11	4
6. A silver fir east of the house	12	5
7. A larch do. do.	8	4
8. A cedar of Lebanon	7	8
9. A cedar of Lebanon	7	4
10. A cedar of Lebanon	8	0
11. Elm	7	10
12. Elm	10	2
13. A tall spruce	7	0

(2.) *Caver's Carre, March* 1860.

1. Silver fir taken 4½ ft. from the ground .	13	6
2. Do. do. do. . .	12	3
3. Do. do. do. . .	12	2
4. A beech do. do. . .	11	4
5. Do. do. do. . .	12	0
6. Do. do. do. . .	10	0

The cedars of Lebanon, with one exception—viz., the largest—seem to have been planted in 1814. They appear to have suffered a little from the severe frost of last winter, the upper branches of some of the trees having rather a scathed-like appearance, with the foliage not so thick and rich as usual. Speaking from memory, I should think these cedars would range about thirty feet in height, or a little more.

12*th December* 1861.—William Brand, Esq. in the Chair.

The following communications were read :—

I. *Notes of a Trip to the North of Italy and Chamouni, in August and September* 1861. By Professor Balfour.

In this paper the author described his visit, along with the Rev. Dr A. Thomson, to Paris, Lyons, Marseilles, Genoa, Leghorn, Pisa, Florence, Bologna, Milan, Turin, Latour and the Waldensian Valleys, Arona, Lago Maggiore, Domo d'Ossola, Simplon, Brieg, Sion, Lausanne, Geneva, and Chamouni, and noticed briefly some of the more interesting plants which had been observed. Among those seen in the neighbourhood of Genoa were enumerated the following :—*Olea europæa, Platanus orientalis, Tamarix gallica, Capparis spinosa. Carthamus lanatus, Medicago sativa* and *falcata, Quercus Ilex* and *coccifera, Nerium Oleander, Mirabilis Jalapa, Euphorbia palustris,* and *Cyparissias, Lactuca Scariola, Punica Granatum, Colutea arborescens, Cercis Siliquastrum, Convolvulus siculus. Ficus Carica, Morus nigra, Myrtus communis, Ornus europæa, Schinus Molle, Pistacia Lentiscus. Centaurea Calcitrapa, maculosa* and *alba, Arbutus Unedo, Clematis erecta, Dianthus Carthusianorum* and *sylvestris, Gypsophila repens, Cytisus triflorus, Spartium junceum, Psoralia bituminosa, Lotus diffusus, Genista germanica* and *cenisia, Dorycnium hirsutum, Senecio albicans, Eryngium campestre, Crithmum maritimum, Rubia peregrina, Scabiosa canescens* and *lucida, Aster acris. Pulicaria dysenterica, Borkhausia setosa* and *fœtida, Carduus defloratus, Veronica spicata, Verbascum Thapsiforme* and *Lychnitis, Scrophularia canina, Euphrasia lutea, Sideritis hyssopifolia, Salvia pratensis, Mentha sylvestris* and *rotundifolia, Phytolacca dioica, Smilax aspera, Allium angulosum, Cynodon Dactylon, Setaria viridis, Panicum Crus-galli, Arundo Donax, Adiantum Capillus-Veneris.* A tolerably full list was given of the plants found on the Vaudois Alps, chiefly from specimens supplied by M. Rostan. The following may be recorded :—

Ranunculaceæ.

Actæa spicata, *L.*
Anemone baldensis, *L.*
Aquilegia alpina, *L.*
Atragene alpina, *L.*
Ranunculus glacialis, *L.*
plantagineus, *All.*
Villarsii, *DC.*

Cruciferæ.

Arabis alpestris, *Sch.*
brassicæformis, *Wall.*
cœrulea, *Wulff.*
muralis, *Bert.*
pedemontana, *Bert.*
Cardamine impatiens, *L.*
pratensis, *All.*
sylvatica, *Link.*
Cheiranthus pumilus, *L.*
Dentaria pentaphyllos, *L.*
Draba aizoides, *L.*
muralis, *L.*
Hugueninia tanacetifolia, *Rchb.*
Hutchinsia alpina, *Br.*
Iberis pinnata, *L.*
Nasturtium pyrenaicum, *Br.*
Petrocallis pyrenaica, *Br.*
Thlaspi alpestre, *L.*
arvense, *L.*
virgatum, *G.*
Vesicaria utriculata, *Lam.*

Papaveraceæ.

Papaver argemonoides, *Cesati.*

Fumariaceae.

Corydalis fabacca, *Pers.*
solida, *Hook.*

Cistaceæ.

Helianthemum alpestre, *Dun.*

Violaceæ.

Viola ambigua, *W. & K.*
canina, *L.*
cenisia, *All.*
collina, *Bes.*
nummularifolia, *All.*
odorata, *L.*
pinnata, *L.*
sciaphylla, *Koch.*
scotophylla, *Good.*
sepincola, *Good.*
sylvatica, *Lam.*
valderia, *All.*

Droseraceæ.

Aldrovanda vesiculosa, *L.*

Polygalaceæ.

Polygala calcarea, *Sch.*

Caryophyllaceæ.

Arenaria verna, *L.*
Villarsii, *Ball.*
Cerastium lineare, *All.*
Dianthus atrorubens, *All.*
deltoides, *L.*
Mœnchia mantica, *Bart.*
Silene nutans, *L.*
Tunica saxifraga, *Scop.*

Linaceæ.

Linum gallicum, *L.*

Leguminosæ.

Astragalus aristatus, *Hert.*
Onobrychis, *L.*
Cytisus alpinus, *Mill.*
nigrescens, *L.*
Lathyrus heterophyllus, *L.*
sylvestris, *L.*
Onobrychis montana, *DC.*
Oxytropis campestris, *DC.*
montana, *DC.*
Phaca alpina, *L.*
australis, *L.*
Trifolium badium, *Sch.*
Molineri, *Balb.*
pannonicum, *L.*
scabrum, *L.*
strictum, *L.*
Vicia pisiformis, *L.*
sylvatica, *L.*

Rosaceæ.

Dryas octopetala, *L.*
Potentilla Fragariastrum, *Ehr.*
minima, *Hall.*
valderia, *Sm.*

Lythraceæ.

Suffrenia filiformis, *Bellar.*

Onagraceæ.

Circæa alpina, *L.*
Epilobium angustifolium, *L.*
Fleischeri, *Hochst.*
rosmarinifolium, *Hænk.*

Illecebraceæ.

Paronychia polygonifolia, *DC.*
Herniaria incana, *Lam.*

Crassulaceæ.

Sedum alsinifolium, *All.*

Saxifragaceæ.

Saxifraga exarata, *Vill.*
  Cotyledon, *L.*
  diapensioides, *Bell.*
  pedemontana, *All.*
  purpurea, *All.*
  valdensis, *DC.*

Umbelliferæ.

Bupleurum ranunculoides, *L.*
Myrrhis odorata, *Scop.*
Plycotis heterophylla, *Koch.*

Galiaceæ.

Galium pedemontanum, *All.*

Valerianaceæ.

Valeriana tuberosa, *L.*

Compositæ.

Achillea nana, *L.*
Adenostylis leucophylla, *Rchb.*
Artemisia glacialis, *L.*
  spicata, *Jacq.*
Chrysanthemum montanum, *L.*
Doronicum austriacum, *Willd.*
  Clusii, *Tausch.*
  scorpioides, *Willd.*
Filago arvensis, *L.*
Hypochæris uniflora, *Vill.*
Senecio incanus, *L.*

Campanulaceæ.

Campanula alpestris, *All.*
  Elatines, *L.*
  stenocodon, *Boiss et Reut.*

Ericaceæ.

Pyrola minor, *L.*
Monotropa Hypopitys, *L.*

Gentianaceæ.

Gentiana brachyphylla, *Vill.*
  ciliata, *L.*
  excisa, *Koch.*
  Rostani, *Reuter.*

Boraginaceæ.

Cerinthe minor, *L.*
Pulmonaria saccharata, *Mill.*

Scrophulariaceæ.

Bartsia alpina, *L.*
Euphrasia lanceolata, *Lam.*
  Odontites, *L.*
  salisburgensis, *Funk.*
Pedicularis fasciculata, *Bellar.*
  foliosa, *L.*
  incarnata, *Jacq.*
  rosea, *Jacq.*
  rostrata, *L.*
  verticillata, *L.*
Scrophularia vernalis, *L.*
Veronica Allionii, *Vill.*
  bellidifolia, *L.*
  urticæfolia, *L.*

Labiatæ.

Calamintha grandiflora, *Moench.*
  piperella, *Reitt.*
Galeopsis angustifolia, *Ehrh.*
  intermedia, *Vill.*
Teucrium lucidum, *L.*
Pinguicula alpina, *L.*
  vulgaris, *L.*

Primulaceæ.

Androsace carnea, *L.*
  obtusifolia, *All.*
Aretia vitalliana, *Lap.*
Primula latifolia, *L.*
  villosa, *Jacq.*

Polygonaceæ.

Polygonum alpinum, *All.*

Scleranthaceæ.

Scleranthus biennis, *Reuter.*

Salicaceæ.

Salix hastata, *L.*

Orchidaceæ.

Orchis incarnata, *L.*
Serapias longipetala, *Pollin.*

Liliaceæ.

Allium sphærocephalum, *L.*
Tulipa præcox, *Tenor.*

Juncaceæ.

Juncus alpinus, *L.*
  capitatus, *Weigel.*
  Jacquini, *L.*
Luzula nivea, *Desv.*
  pedemontana, *Boiss et Reut.*
  spadicea, *DC.*

Cyperaceæ.
Carex curvula, *All.*

Gramineæ.
Agrostis pumila, *L.*
Aira flexuosa, *L.*
Alopecurus Gerardi, *Vill.*
Avena versicolor, *Vill.*
Bromus squarrosus, *L.*
Festuca flavescens, *Bill.*
Oreochloa pedemontana, *Boiss et Reut.*
Poa cenisia, *All.*
Stipa Calamagrostis, *Whlberg.*
Vulpia ligustica, *Rchbch.*

Equisetaceæ.
Equisetum variegatum, *Sch.*

Filices.
Asplenium fontanum, *DC.*
Blechnum Spicant, *L.*
Lastrea dilatata, *L.*
rigida, *Presl.*
Polypodium Robertianum, *Hoff.*
Woodsia hyperborea, *R. Br.*

The author gave details of his visit to Chamouni, the Brevent, Flegère Montanvert, the Jardin, Tête noir, and Martigny, in company with Mr C. Cowan and Mr Thomas Chalmers. The following were some of the plants collected in the Jardin district:—

Cardamine resedifolia, *L.*
Arenaria biflora, *L.*
Silene acaulis, *L.*
rupestris, *L.*
Trifolium alpinum, *L.*
Alchemilla alpina, *L.*
Potentilla grandiflora, *L.*
Epilobium alpinum, *L.*
Sempervivum arachnoideum, *L.*
Saxifraga aizoides, *L.*
aspera, *L.*
bryoides, *L.*
stellaris, *L.*
Astrantia minor, *L.*
Athamanta cretensis, *L.*
Bupleurum stellatum, *L.*
Meum mutellinum, *Gœrtn.*
Apargia alpina, *Hust.*
autumnalis, *Willd.*
Adenostylis alpina, *B. et F.*
Carduus spinossissimus, *L.*
Carlina acaulis, *L.*
Chrysanthemum alpinum, *L.*
Hieracium alpinum, *L.*
angustifolium, *Hopp.*
aureum, *Scop.*
cymosum, *Vill.*
Gnaphalium alpinum, *L.*
Senecio incanus, *L.*
Tussilago alpina, *L.*
Campanula Trachelium, *L.*
Phyteuma humile, *Sch.*
spicatum, *L.*
Vaccinium uliginosum, *L.*
Vitis-Idæa, *L.*
Gentiana purpurea, *L.*
Euphrasia salisburgensis, *Funk.*
Linaria alpina, *Desf.*
Veronica saxatilis, *L.*
Acinos vulgaris, *Pers.*
Primula glutinosa, *L.*
Juniperus communis, *L.*
Luzula spadicea, *DC.*
Carex fœtida, *All.*
Agrostis alba, *L.*
alpina, *Scop.*
vulgaris, *With.*
Alopecurus pratensis, *L.*
Phleum alpinum, *L.*
Poa alpina, *L.*
laxa, *Hœnke.*
Allosorus crispus, *Bernh.*
Bryum androgynum, *Hed.*
Cetraria islandica, *Ach.*

He also described what he had seen of the remains of the guides who had perished by the avalanche during Dr Hamel's ascent of Mount Blanc in 1820. These remains made their appearance in July 1861, in the Glacier Bossons. They consisted of bones, teeth, hair, the remains of hat, gaiters, buttons, mittens, lantern, and baton. Their appearance at this period confirmed the statements of Principal Forbes as to the movements of glaciers.

During the whole excursion the heat was excessive,—Fahrenheit's thermometer rising to upwards of 90° in the shade. The vegetation had suffered much from the heat and drought. The Arno, at Florence, could be crossed at some parts dry-shod, and the melting of the glaciers gave rise to inundations in the valley of the Rhone.

The paper was illustrated by specimens of the plants collected.

2. *Notes on the* Cyperaceæ—(1.) Carex Grahami (*Boott*): (2.) Scirpus (Eleocharis) uniglumis (*H. C. Wat*). By BENJAMIN CARRINGTON, M.D., Lincoln. Communicated by Professor BALFOUR.

(1.) *Carex Grahami*, Boott.

While engaged making drawings of the *Carices*, some time ago, I found, mingled with specimens of *C. saxatilis*, L., from Glen Fee, Clova, two or three plants of larger size, and differing in several respects from the rest. The spikelets were larger, straw-coloured. Glumes acute, much shorter than the pale *elliptic-oblong*, inflated perigynium, distinctly 4–5 *ribbed*. The nut was *abortive* in all the spikes, although mature nuts were present in *C. saxatilis*. The perigynium of the latter is of smaller size, *oval*, *ribless*, and like the glumes, which it equals in length, of a *deep purple* colour. These characters led me to identify the plant with *C. Grahami*, which Dr Boott appears to have considered a good species.

Wishing to obtain more information, I wrote to Professor Balfour (May 1858), and he was good enough to forward me the specimens preserved in the College Herbarium.

In his reply, he remarks, that "*C. Grahami* is confined to one spot in Glen Fee, pretty high up on the rocks; whilst *C. saxatilis* occurs commonly in marshy ground, on most of our high hills."

The significance of this information will be better understood, when I state, that in one of the Herbarium specimens, we find, springing from the same rhizome, spikes apparently of both kinds. The one, having the dark, ribless perigynium of *C. saxatilis*; the other, the large, stinted, and abortive fruit of *C. Grahami*. We frequently meet with deformed perigynia in *Carex intermedia (disticha)*, accompanied by abortion of the nut.

This change is probably due to some morbid action of a local nature, by which the growth of the germen is arrested, and the perianth is developed at its expense.

C. Grahami retains all its peculiarities under cultivation, and looks even more unlike *C. saxatilis*. When in Ireland (June 1861), Mr D. Moore, of Glasnevin, was kind enough to show me fruiting plants of both kinds. Upon dissection, however, I found the fruit of *C. Grahami* enclosing only the undeveloped germen, as in the wild specimens.

(2.) *Eleocharis palustris, and its Allies.*

In the fourth edition of "Babington's Manual," we find descriptions of three species of *Eleocharis*, with lenticular fruit, dilated articulate styles, and two stigmas.

Having carefully dissected the species, the following notes may be found useful to others. It should be understood that all descriptions of the fruit refer to the ripe Caryopsis. Plants with mature fruit, especially of the rarer species, are obtained with great difficulty. This may account for inaccuracies of detail, even by such careful observers as Professor Babington. Thus he calls the fruit of *E. palustris*, round-obovate; of *E. uniglumis*, pyriform; and *E. Watsoni*, oblong; whereas I have invariably found that of the first *exactly obovate*, and of the two latter *bluntly rotund-obovate.*

Eleocharis palustris, L.—*Rhizome* extensively creeping, woody, giving off fascicles of stems from the upper surface of the nodes, and fibrous roots below. *Stems* 6 to 12 inches high, terete, finely striate, the interior filled with large membraneous tubes, but without central pith. *Sheaths* purplish-brown, *glossy*, the upper one tight, *truncate*, with an *obtuse angle* on one side. Leaves none, although the barren stems may be mistaken for leaves. *Spikes* ovate or ovate-oblong, solitary, terminal. *Glumes* purple, ovate, acute, with a green midrib, and broad membraneous edges; the *two lower glumes equal*, shorter, and more obtuse than the rest. *Bristles* 4, setaceous, as long as the fruit, with recurved teeth, dilated and smooth at the base. Stigmas 2, downy, equal to the dilated, battledore-shaped, persistent, jointed style. *Caryopsis* pale-brown, lenticular, obovate, with blunt margins; the surface polished, finely striate, and covered with narrow, oblong reticulæ.

Eleocharis uniglumis, Link.—In its creeping rhizome, glossy obtusely truncate sheaths, and general habit, this plant resembles the former so closely, that many botanists look upon it as a mere uniglume variety of *E. palustris.* It is far from a good species. But in the present state of uncertainty as to the limits of species, it is perhaps better to give a name to a permanent variety, than leave it undescribed. It differs chiefly in the *lower glume* being single, and enclosing the base of the ovate spike. The base of the *style* is less constricted, *broader*, and *triangular* or pyramidal in form. *Fruit* smaller, *rotund-obovate*, more tumid and biconvex, glossy, the surface beautifully *excavato-punctate*, like the marking on a thimble. The cells are larger, and round in this species, and *E. Watsoni;* whereas, in *E. palustris* they are narrower, giving the nut a more striate appearance.

β. Watsoni. *Eleocharis Watsoni*, Bab., Annals Nat. Hist., Ser. 2, x. 32. Through the kindness of Professor Balfour, I have been allowed to examine the remnant of the original specimen, shared with Professor Babington. It consists of three stems, from 2 to 3 inches high, broken off close to the rhizome. These might readily be overlooked as a stunted variety of *E. pauciflorus*, but the sheaths are purple and *polished*, and *obtusely truncate*, as in the former species. The *lower glume* is solitary, obtuse, surrounding the base of the spike, the upper glumes more acute. *Nut* orange-brown polished, *bluntly rotund-obovate*, compressed, with rounded margins, excavato-punctate, and crowned with the broad triangular style, exactly as in *E. uniglumis.* The only point of difference seems to be the comparative length of the *bristles.* They are four in number, and dilated at the base, as in the former, but only *about half as long* as the ripe fruit. I observed, however, that they were relatively longer in some of the upper and less mature florets; and as the bristles are known to be more sportive than any other organs throughout the Scirpeœ, this character can only entitle it to be ranked as a variety (perhaps an alpine state) of *E. uniglumis.* Babington describes the fruit as oblong, but this can only apply to the immature germen; it is when ripe nearly round, slightly narrowed at the base.*

The species may be thus defined:—

Stigmas 2, style jointed, bristles 4, retrorsely hispid.

1. *E. palustris*, L. Rhizome creeping, sheaths polished, obtusely truncate, two lower glumes equal, nut smooth, finely striate, obovate, compressed, crowned by the ovate base of the style, bristles 4, longer than the germen.
2. *E. uniglumis*, Link. Rhizome creeping, sheaths obtuse, lower

---

* *E. pauciflorus* may be distinguished from it by its 3 stigmas, trigonous nut, and the style not being jointed.

glume solitary, nut lenticular, rotund-obovate, polished, excavato-punctate, surmounted by the triangular base of the style, and shorter than the 4 bristles.

β. *Watsoni.* Glumes rather obtuse, bristles 4, about half the length of the nut.

Mr. M'Nab laid before the meeting several sections of Scotch fir beams, taken from the ruins left by the late catastrophe in the High Street of Edinburgh. These beams had been originally prepared by a rough squaring with an axe, as the corners of each present a smooth appearance, showing where the bark had been removed; and several portions had the bark quite entire, unmistakably proving them to be Scotch fir. In most cases the timber is in excellent preservation, particularly the centre or hard wood. The beams are generally of small sizes, varying from five to eight and ten inches in diameter. The annual circles are very distinct, averaging about fifty-seven in each, showing that the timber, when cut down, was under sixty years of age. He had examined most of the beams while lying for sale in the Green Market, and found that, where the annual rings could be counted, the trees appeared to be all about the same age. Judging from the long and thin nature of the stems, they must have grown very close together; but whether they are Boroughmuirhead or Aberdeenshire timber, it is difficult to say. If the beams were made of Boroughmuirhead fir, one would suppose that they should have been of much larger size and considerably older. It is doubtful if timber sawn up for rough building purposes, as now used, will last as long as timber with all its heart-wood entire—such as has been employed in these old buildings. A few large sawn fir beams 1 foot broad and 7 inches thick, with large annual rings, were likewise seen amongst the ruins; but their ages could not be ascertained, as they are only the centres of trees. Their freshness, their rarity, and being sawn into their present shape, would make one suppose them to have been of more recent date than the mass of axe-dressed timber. A few beams of oak were also got amongst the ruins—rough axe-squared, similar to the Scotch firs—the outer or sap wood very much decayed, while the inner or heart-wood was quite perfect, and very dense. Their supposed age when cut must have been about eighty years.

Mr J. Sadler stated to the meeting that in the "Phytologist" for this month (December 1861), at page 578, it is stated, on the authority of an anonymous collector, that *Saxifraga cernua* occurs abundantly on Ben Ledi. This he looked upon as a mistake. The collector had probably mistaken *Saxifraga nivalis* for *S. cernua*. Mr Sadler and many others, including Professor Balfour and his class, had visited Ben Ledi, and examined it carefully, but had never seen *Saxifraga cernua*, which in Britain seems to be wholly confined to Ben Lawers.

Mr William R. M'Nab exhibited specimens of *Coleoptera* he had received from George Patton, Esq., which had been destroying the *Coniferæ* in the Pinetum at the Cairnies, Perthshire. *Hylobius abietis*, Linn., the pine-weevil, and *Gonioctena litura*, Fab., seemed to be the insects that did the mischief; but the most remarkable fact was the occurrence of *Mysia oblongoguttata*, Linn., which, in company with a very large number of *Anatis ocellata*, Linn., had committed such havoc in search of the Aphides on which they feed, that the value of Lady-bugs in destroying these Aphides was doubted; and when they occurred in such numbers as they were found by Mr Patton, they had become positively injurious.

Mr W. R. M'Nab also exhibited a piece of the bark of *Wellingtonia gigantea* acted upon by a salt of iron, which indicated the presence of tannin.

Mr R. Brown laid before the Society several specimens of the following rare or remarkable *Algæ* from Brighton:—

(1.) *Dasya*, sp.? allied in the form of its vesicles to *Dasya ocellata*, and in its habits to *Dasya arbuscula;* closely connected, if not specifically the same, with *Dasya punicea* of the Mediterranean.

(2.) *Phyllophora*, sp.? allied to *P. rubens*, but apparently distinct, if specimens connecting the two forms are not found.

1st, With tubercular fruit wrinkled with sinuous processes.

2d, With leaflets covering nemathecia.

3d, The same less advanced, or another form of fruit.

4th, A branch to show the mode of growth, the fronds proliferous from *near* the apex, whence they spring with a short stem.

The habitat is among sponges, *Rytiphlæa pinastroides*, *Nitophyllum laceratum*, &c.

(3.) Fresh and dried specimens of the rare *Codium Bursa*, Ag.

These specimens had all been found by Mrs Merrifield, the authoress of the "Natural History of Brighton," and examined by Professor Harvey of Trinity College, Dublin, who had expressed his opinion as above.

(4.) Many specimens of *Cladophora Merrifieldiæ*, which, owing to his absence from Britain at the time when the communication describing it was read to the Society, he was unable to exhibit. He remarked that at the time he described it he did not consider it as certainly a permanent form of that very difficult and changeable genus, but that, being more distinct than many species of the genus already described, it was well to note the form. It may be classed under the same category as *Cladophora Gattyæ*, Hass., whose specific claims must, it is to be feared, remain for long *sub judice.*

(5.) *Cladophora glomerata*, Hass.[*]

Mr Brown also exhibited beautifully carved spoons (made out of a single piece of the sugar maple) from the bazaar of Ispahan, and used by the Persians in drinking their national beverage—sherbet.

Royal Physical Society.

Wednesday, 27th November 1861.—T. Strethill Wright, M.D., President, in the Chair.

The President gave an opening address, in which, after recording the work of the previous session, and noticing the death of Professor More, and the removal from Edinburgh of Mr A. Murray and Dr Cleland, he remarked;—

Good steady work has been done, and patiently recorded. We are men of work, not of talk. We have given forth no voice on the grand hypothetical questions which are now troubling the commonwealth of Natural Science. We have been singularly apathetic as to whether or no, the stock of our first parent struggled upwards through innumerable adversities from a monad to a man. I fear, indeed, that we are prejudiced people, and would rather leave the question as we found it settled many a year ago at our mother's side. We have given no opinion, as to whether the king of the Gorillas died gloriously advancing on his terror-stricken foe, and beating a far-resounding tattoo on his tympanic chest, or whether

---

[†] Brit. Fresh-Water Algæ, i. 213. Microspora glomerata (Hass. in Ann. Nat. Hist.) Conferva glomerata, Dill. Conf. t. 13.

he was brought to the ground by a rifle-shot in his cerebellum, while ignominiously bolting up a tree. But we have been jotting down hard little facts, rough diamonds, which by-and-by we may see taken up and ground, and polished, and set by other hands,—central points of crystallization, which we may find dotting the pages of great standard volumes, and glimmering from amid the small type of their foot-notes and indices. *Sic itur ad astra.* These small facts are the foundations of adamant on which the vast inverted pyramids of science are balanced. In their discovery they are providential revelations, which, though neglected for ages, may in a moment endow mankind with unhoped for welfare and prosperity. How often have men, dreaming of the transmutation of all metals into gold which would be useless, of the attainment of the Elixir which would confer a dreadful immortality, cast aside the talent placed within their hands, and all that would have made the life ordained for them useful and happy? How often, while invoking all nature to furnish them with the impossible Roc's egg, have they pushed aside the little, dusty copper lamp, which, in return for diligent rubbing, would have invested them with the powers of the genius of Arabian fable! How little did he, who first noticed the attractive property of the loadstone, imagine that to him was revealed a power which would one day guide the commerce and navies of the world over the pathless seas,—which would veer off the floating city, laden with the hopes of a thousand human hearts, and careering over the dark waves with the speed of the wind, from the treacherous iceberg and the crashing floe,—which would link together in the closest bonds all the kingdoms of the earth,—which could correlatively transmute all the forces of nature—and which may one day render the great sea itself one mighty storehouse of fuel and power for the benefit of mankind! How little did he, who first linked together an atom of hydrogen with two of carbon and three of chlorine, dream that then was revealed to mankind the beneficent Elixir which would cause that dread and ancient travail of the woman to cease,—which would change the despairing moan and the agonizing terror of the operating table for a calm and dreamless slumber, and which shall render the fame of Dumas and Simpson undying, until the stream of time shall flow for suffering humanity no more! So it may happen that some unambitious observation made here may throw unexpected light on the geology of our country,—may endow vast districts with mineral wealth undreamt of,—may modify all our received views of cell-life—and put down a hard little point, on which may rise the Physiology and Pathology of the future. Let us therefore go on as we have done, not urged by the desire of fame or notoriety, but constrained by the love of knowledge and truth.

Our Society has still another function. It plays its part as an exponent, through its reports in the daily press, of the progress of Natural Science—a knowledge which cannot fail sooner or later to give a higher tone to the literature and cast of thought of our country. It is painful to notice how the writings of many of the most talented and accepted authors of our day are entirely uninfluenced by the sublime realities of Creation,—realities which excel in their grandeur the most transcendent dreams of the imagination. The poet who prates of "the pale cold moon," and the "throbbing and pulsing stars," as the bashful witnesses of some illicit love affair, entertains or feigns an infinitely more degraded conception of his relation to the Universe in which he is placed, than the child who lisps at evening,—

"Twinkle, twinkle, little star,
How I wonder what you are."

For that wonder, which accompanies the little one in this his first step towards the attainment of truth, will go hand in hand with him, until in after years he may have sounded all the known depths of the Cosmos. By-and-by he will look upwards to the Firmament in the night season with the astronomer, and see, in the luminous pathway which is extended on high, an awful system of suns—a mist of suns—of whose vast size and distance from each other, numbers fail to impart to the human mind any conception. Each shining particle of that dense sun-cloud, he is told, wondering, is separated from its neighbours by sixty millions of millions of miles. He finds that one such particle alone has been measured, weighed, and analysed;—it is a vast globe wrapped in a sea of the intensest flame, well-nigh 200,000 miles around;—that this vast furnace, this infinitesimal particle of sun-mist, is slowly moving across the cloud of its fellow suns; yet though it should glance with the speed of light for twenty thousands of years, its journey would still be unaccomplished;—that this almost immeasurable Universe of suns is but a speck in a cloud of grander Universes separated from each other by still more immeasurable wildernesses of darkness extending into infinity for ever. In these unfathomable abysses, he views the wheeling of planets around their sun in slowly rocking orbits,—of suns linked in circling round with their fellow suns, blue, and orange, and green, and crimson,—of Universe linked with Universe,—of immeasurable rings and clusters, and complicated spiral whirlpools, lustrous with countless myriads of suns. But who shall recount to him the unimaginable mysteries of being,—of life, and mind, and soul, called forth by the voice of the Almighty, around each radiant centre!—Who shall report "their holy triumphs out of evil wrung!"—Who shall tell of the great Hosanna, rising throughout these illimitable creations, for ever before the all-pervading mercy-seat of God.

Again, this green duck-pond presents no inviting or miraculous appearance. But the philosopher, still a wondering child, places a drop of its slime under the highest power of the microscope, and a world of beautiful fish-like creatures starts into view,—the green Euglenas. He notes the accurate wave-lines of their taper forms,—the long, lashing trunks by which they scull themselves along,—the brilliant crimson eye-speck, which hints of a sense perhaps unknown to man,—the wonderful provision made for their multiplication and preservation,—how a single Euglena, by incessant self-division, becomes an infinite host,—how, when the summer sun is drying up the puddle which is its Universe, it seals up itself in a cell of horn, like the Indian Fakir, and lies hard and dry in the mud, or floats a speck of dust upon the breeze, until a welcome shower restores it to liberty and life, when it creeps out of its cell again, not one, but a swarm of little Euglenas. The filthy scum, that coats the common sewer, and hangs in long floating fringes from every stick and stone in our Water of Leith, becomes in like manner transformed into vast assemblages of the most wonderful and beautiful of all animalcules,—into forests of Carchesium, each animal of which is as a many-branched tree of glass,—each branch instinct with life, slowly extending, or quickly contracting itself in convoluted spirals,—each twig crowned with its vase-shaped zooid, wreathed with a whirling glory of never-resting cilia; there is the contractile heart; there the circling round of moving fluids that ceases not but with life. So the vile things of Nature teem with the beauty of invisible existences,—mutter to the attentive ear mysterious life-histories of deeper import than the astronomer's record of all those infinitudes of wandering fire. Each day the sea, slowly creeping back from its weedy shores, calmly reveals unknown and inexhaustible treasures, or, driven into fury by the storm, casts at our feet rarer gems from its deeper storehouses. Each night its waves glitter with sparks of living light, the handiwork of a Providence which never slumbers nor sleeps. Night after night, o'er all the tide-lashed margins of the deep, the kingdoms of the great Polyp-world blaze before the Lord. All the day long stretch they forth their arms motionless to take their meat from His hand. These, seen but by the seeker, wreathing the worn rocks with garlands of living flowers;—these, towering up from the sombre depths of the Norwegian fiords, lofty as mighty forest trees;—these, clear and tiny as drops of dew, bounding along the surface of the summer seas;—these, slow wheeling like stately argosies, trailing their fringed streamers in graceful spirals many a foot behind;—these, God's workers from the beginning, raising against the Pacific surges vast barriers, before which all the proud erections of man dwindle into insignificance, and which shall endure when the boasted monuments of his religion and his fame shall have crumbled into dust.

Again, our philosopher, still a wondering child, can look back with the geologist, and see "as in a glass darkly," the earth primeval and void, brooded over by the creative spirit of the Almighty. He can view the traces of those mighty elemental wars, those slow millions of years, that lifted the land from the deep;—those slow millions of years, when the early foliage was creeping over its denuded surface, and the unfolding beauties of the radiata and the mollusc received the approving fiat of Him for whose pleasure they are and were created;—those slow millions of years, when the brood of the dragon reigned; when gigantic Saurians trailed themselves through the plashy marshes, darted fish-like through the waters, or, poised on bat-like wings, filled the dank air with bellowing croaks and shrill whistles; there, where ages upon ages afterwards, the wolf howled amidst the dense oak forests of Britain, and snuffed the human holocausts of hordes of naked and painted savages; there, where the well-drained land now whitens yearly with a varied harvest, where the flying express and the electric wire obey the behests of a grave and thoughtful people, where through the summer and autumn time is heard the song of the reaper, and where innumerable church bells proclaim the preaching of the Gospel of Peace. Alas! round each church tower still arises a sad under-song of misery and sin, and borne on the wind comes from the distant ocean the boom of giant instruments of death. Yet, looking back into the past, he can also discern, as in a glass darkly, the future. He can hopefully look forward to that glorious time when, as the old Saurian reign has ceased, so the reptile reign of Sin shall cease, and a renewed race, clothed in the majesty of an innocent manhood, shall lift up their eyes radiant with the indwelling Spirit of the Almighty, and look into the deepest mysteries of God.

Millions of millions of years!—Sad voices cry, "Oh, watchman, what of the night!" "Watchman! will the night of sin never be passed!" But already, those standing on the mountain tops are stretching their hands towards the east. Already, the first glad beams of the World's great day are glancing on their longing eyes. Already, to those waiting in the chill hour before the dawn, is creeping the murmur of innumerable voices as of distant seas awakening 'neath the sun, telling of the slow advance of those beneficent powers which shall make a bloodless conquest of the world, until all its kingdoms shall become the kingdoms of our God and of his Christ.

> The mills of God grind slowly, yet they grind exceeding small;
> With patience he stands waiting, with exactness grinds he all.

Such are the teachings of Nature;—such the hopes it inspires. In the highest and the lowest,—in the grandest and the meanest,—the perfect working of a perfect God,—ever putting forth through the slowly lapsing ages still nobler manifestations of His Wisdom and His Power. For the present—rest; for the future—unbounded confidence and hope.*

---

* While these lines are being corrected for the press, Edinburgh is shaken by cannon—booming for a great and peaceful victory. A true and noble man hath

Dr Wright then proceeded with his report on the anatomy of the *Hydroidæ.*

The following communications were read:—

1. *Observations on British Zoophytes.* By Joshua Alder, Esq.

(1.) *Hydractinia areolata.—Polypary* encrusting, consisting of a solid chitinous expansion, from which rise simple linear spines in irregular groups, leaving areolar spaces between them. *Polyps*, naked, small. white, columnar, slightly expanding above, and terminated by a conical mouth, below which is a single circle of from six to ten rather slender tentacles, appearing of different lengths from their varying contractibility. Gonophores sessile, large, globular, or slightly pear-shaped, containing each a single medusoid. *Medusoid*, with a moderately deep sub-globose umbrella, with four golden-yellow radiating canals, at the bulbous base of which are four rather short tentacles; four shorter ones alternate with them, and between each again are eight others, almost tubercular. The peduncle is rather long, columnar, white, with four tufts of thread cells surrounding the mouth.

On a small *Natica Alderi*, from deep water, Cullercoats.

(2.) *Atractylis arenosa.—Polypary* minute, consisting of a creeping fibre, from which arise short funnel-shaped tubes, rather irregular in form, but always expanding more or less at the top. *Polypes* entirely retractile, with long, slender, strongly muricated tentacles, varying in number, according to age, from six to twelve. The polypary is usually covered with minute grains of sand.

On stones and the roots of *Laminaria*, within tide-marks, at Tynemouth and Cullercoats.

Dr Wright stated that he had found this zoophyte at Largo, in autumn last, and had observed its mod eof reproduction, which was unique amongst the Tubulariadæ.

2. *On the Anatomy of Sacculina.* By John Anderson, M.D.

3. *On Reproduction in Æquoria vitrina.* By Dr Strethill Wright.

In vol. i. of Agassiz's "Natural History of the United States," the following passage occurs:—"As to the Æquoriadæ, I have no doubt that they are genuine hydroids, though I have not been able to trace with certainty the origin of the Æquoria of our coast to any true hydroid. But the structure of Æquoria in its adult Medusa state is so strictly homologous to that of all the naked-eyed Medusæ, that even if it were ascertained that it undergoes a direct metamorphosis from the egg to the perfect Medusa, I would not hesitate to consider it as a member of the order of Hydroids, since it has simple radiating aquiferous tubes, a circular canal, and marginal tentacles closely connected with it, and provided with minute pigment spots at the base." Agassiz was doubtless correct; and he might also have predicted that it belonged to the genus Campanularia or

laid aside his titles, and honours, and power; and hath passed from the uncertain and turbulent shadows of this world, to the serene light of the eternal day. Gentle, and wise, and good,—earnest in the work of the present,—he was of those who, standing on the mountain tops, gaze wistfully on the brightening dawn of the future. "*Nobody*," saith he, who being dead yet solemnly speaketh—"*Nobody who has paid any attention to the peculiar features of our present era, will doubt for a moment, that we are living at a period of most wonderful transition, which tends rapidly to accomplish that great end to which, indeed, all history points*—THE REALISATION OF THE UNITY OF MANKIND. (Speech of the Prince-Consort at the Lord Mayor's Banquet, 1850.)

Laomedea, as it corresponded with those genera in the presence of otoliths. In the beginning of this month (November) my friend Mr Fulton, to whom I owe so much, sent me two living specimens of *Æquoria vitrina*,—one about three inches in diameter, the other about six inches and a half. The number of lips of the latter was about forty, the radiating canals, each having a long ovisac, about eighty, and the marginal tentacles, by estimation, four hundred. On examining the ovaries, I found that the eggs were hatched, and the young, in the form of almost invisible planulæ, were issuing from the ovisacs. These were gently extracted with a glass syringe, an instrument so useful to those who practise the obstetric art amongst the hydroidæ, and were placed about three weeks ago in glass tanks of clean sea-water prepared for their reception. Many thousands of larvæ were placed in the tanks, and of those, about a score have been developed into Campanularian polyps, about a hundred are still progressing to that end, and the rest have disappeared. It was with no little impatience and anxiety that I saw the Planula during a fortnight fix itself to the glass, spread itself out into a short thread, secrete its scleroderm, put forth its polyp-bud,—this last slowly swelling day by day, until at last it opened, and a polyp appeared, furnished with twelve alternating tentacles, joined together for about one-third of their length by a web, the polyp enclosed in a cell terminating in many acuminate segments. It is now about six years ago that I was watching in like manner the slow evolution of a bud from a Campanularian Zoophyte, the *Laomedea acuminata* of Alder,—the Campanulina of Van Beneden,—the bud opened, and a bright green medusoid issued forth, having four lips and two tentacles. The polyp form of *Æquoria vitrina* is, as far as I can determine, identical with that of *L. acuminata* in shape; but is so excessively small,—quite invisible to the naked eye,—that we must wait for further development before we can determine their identity. Geganbaur has proved that the medusoid of Velella acquires a further number of canals and tentacles; and I have elsewhere recorded the successive changes which occur in the medusoids of several species of Atractylis. It is also certain that such increase in the number of elements does occur in *Æquoria vitrina*, for the smaller specimens have always a less number than the larger. Meantime, the questions as to the larval state of *Æquoria vitrina* is settled. This, the largest of all the naked-eyed Medusas, is the reproductive phase of one of the smallest of all the Hydroidæ.

Monday, 16*th December* 1860.—Alexander Bryson, Esq , President, in the chair.

It was moved by George Logan, Esq., and unanimously agreed to, that, on account of the deeply lamented death of H.R.H. the Prince-Consort, the Society do adjourn to the fourth Wednesday of January.

SCIENTIFIC INTELLIGENCE.

GEOLOGY.

*Coal.**—In the year 1853 a remarkable trial took place at Edinburgh before the Lord-Justice-General and a special jury to try the question

---

* In anticipation of a full review of Dr Percy's admirable work on Metallurgy, we have quoted the following remarks on Coal, as having reference to questions of interest at the present day.—(Ed. *New Phil. Jour.*)

"What is coal?" The owner of an estate had granted a lease of the *whole coal* contained in it. In the course of working, the lessees extracted a combustible mineral of great value as a source of coal-gas, and they realised a large profit by the sale of it as gas-coal. The lessor then denied that the mineral in question was coal, and disputed the right of the lessees to work it. At the trial there was a great array of scientific men, including chemists, botanists, geologists, and microscopists; and of practical gas-engineers, coal-viewers, and others, there were not a few. On the one side it was maintained that the mineral was *coal*, and on the other that it was a *bituminous schist*. The evidence, as might be supposed, was most conflicting. The judge, accordingly, ignored the scientific evidence altogether, and summed up as follows: "The question for you to consider is not one of motives, but what is this mineral? Was it coal in the language of those persons who deal and treat with that matter, and in the ordinary language of Scotland? *because, to find a scientific definition of coal, after what has been brought to light within the last five days, is out of the question.* But was it coal in the common use of that word, as it must be understood to be used in language that does not profess to be the purest science, but in the ordinary acceptation of business transactions reduced to writing? Was it coal in that sense? That is the question for you to solve." The jury found that it was coal. Since this trial the same mineral has been pronounced *not to be coal* by the authorities of Prussia, who accordingly have directed it not to be entered by the custom-house officers as coal.

From what precedes, it is evident that it is not easy to frame a precise definition of the term coal, either in a commercial or in a scientific sense. The substances to which the term coal is usually applied differ widely both in physical and chemical characters. All coal results from the decomposition of vegetable matter under special conditions, and in degree of decomposition there is every stage. Thus, at one extreme is lignite, some varieties of which closely resemble wood both in composition and appearance; and at the other is anthracite, which consists almost wholly of carbon, and is, in all respects, unlike wood. Again, the proportion of earthy matter, or ash, in coal is subject to great variation. Suppose a mineral to consist of 5 per cent. of coal-like, black, combustible matter, in all respects similar to undoubted coal, and of 95 per cent of earthy matter. No one would designate such a mineral as coal. Then the question arises, What is the *maximum* amount of such matter which can exist in coal? No definite answer can be given. In the present state of science, I do not believe it possible to propose an exact definition of the term coal. Geological position does not afford satisfactory grounds for a precise definition; for the mineral which was the subject of investigation at the trial in Edinburgh occurs in association with coal of the true Coal Measures; and true coal, so far as may be inferred from the assemblage of chemical and physical characters, is met with in other and more recent geological formations. Perhaps the nearest approach to a definition would be the following: Coal is a solid mineral substance, more or less easily combustible, varying in colour from dark brown to black, opaque—except in extremely thin slices—brittle, not fusible without decomposition, not sensibly soluble in ether, benzole, chloroform, or turpentine—not containing sufficient earthy matter to render it incapable of being applied with advantage as a source of heat in ordinary fire-places or in furnaces. This would exclude amber and other resinous matters, bitumen, and bituminous schists when they contain so large an amount of earthy matter as to be incapable of being employed as fuel; and, I think, it would also exclude even the most compact varieties of peat, none of which can be properly considered as brittle.

My friend Dr Bennett has proposed a definition of coal founded on the appearance, under the microscope, of certain rings in a well-made transverse section; and he maintains that by means of this appearance all kinds of coal, whether household or cannel, can at once be distinguished from the Torbanehill mineral. I do not, however, find that this distinction has been accepted by histologists. Dr Bennett repudiates the verdict of the Scotch jury. He writes, "At the trial it was very plausibly argued that, in a bargain between man and man, scientific truths were of no value, and that a whale among whalers was still a fish. But as no naturalist, conversant with the structure and functions of a whale, would for a moment suppose it to be a fish because it inhabits the water and resembles one, so, I contend, no histologist acquainted with the structure and properties of the Torbanehill mineral ought to maintain that it is coal because it is dug out of the earth and burns in the fire."

Whatever difference of opinion there may be respecting the mode of accumulation of the great deposits of coal,—whether these deposits have, like peat, been produced *in situ*, or whether they have been derived from drift-wood,—there can be no doubt that coal, as has been previously stated, is the product of the decomposition of vegetable matter under special conditions. If we study the analyses of coals, we can readily select a series which illustrates the gradual passage of woody tissue into anthracite, or that variety of coal which consists almost wholly of carbon. Such a series is presented in the following tabular form, the proportion of carbon being estimated at the constant amount of 100:—

	Carbon.	Hydrogen.	Oxygen.
1. Wood (from mean of analyses 1—26)	100	12·18	83·07
2. Peat	100	9·85	55·67
3. Lignite, average of 15 varieties	100	8·37	42·42
4. Ten-Yard coal of the South Staffordshire basin	100	6·12	21·23
5. Steam coal from the Tyne	100	5·91	18·32
6. Pentrefelin coal of South Wales	100	4·75	5·28
7. Anthracite from Pennsylvania, U.S.	100	2·84	1·74

From this it will be perceived that through these various stages of conversion the proportion of carbon relatively increases, while that of the hydrogen and oxygen decreases.

If we examine the relation between the hydrogen and oxygen in these successive degrees of conversion, we shall find that, with the exception of anthracite, there is a steady increase in the proportion of hydrogen beyond that required to form water with the oxygen present. The following numbers express this gradual increase in the excess of hydrogen:—

	Hydrogen.		Hydrogen.
1.	1·80	5.	3·62
2.	2·89	6.	4·09
3.	3·07	7.	2·63
4.	3·47		

The formation of these products of the decomposition of woody tissue may be explained by the elimination of hydrogen in combination with carbon as *marsh-gas*, of oxygen in combination with carbon as *carbonic acid*, and of hydrogen in combination with oxygen as *water*. That the derivation of coal from woody tissue has been accompanied with the evolution of marsh-gas, might be inferred from the nature of the gases generally occurring in coal-mines, of which that gas is the chief constituent. However, the hydrogen and oxygen are never completely separated, as these elements are always present in sensible proportion in anthracite, which is furthest removed from woody tissue in composition.

Nitrogen is always found in coal, and its proportion seems to range pretty constantly between 1 and 2 per cent. Although nitrogen does not appear to be an essential element of woody tissue, yet that tissue is always associated with nitrogenous matters, so that the source of nitrogen in coal is readily accounted for. Hence ammonia is generated in the dry distillation of coal, and the product is consequently alkaline. In the dry distillation of woody tissue, on the contrary, the product is acid, owing to the presence of free acetic acid.

Sulphur is always present in coal. It may exist in the state of sulphuric acid in combination with a base; in combination with iron as iron pyrites or bisulphide of iron; and probably also in combination with the organic elements of coal as it exists in albumen. It chiefly occurs in the state of iron pyrites. In the dry distillation of coal a portion of it is evolved partly as sulphuretted hydrogen and partly as bisulphide of carbon.

All coal contains a greater or less proportion of water, which may be expelled at or slightly above 100° C. A coal may appear perfectly dry, and yet lose by desiccation a very large amount of water; as much even as 20 per cent. Whether the water exists wholly as hygroscopic water, or whether, in some cases, it may not be partially combined, is doubtful; yet facts will be advanced in the sequel which seem to support the latter view. The amount of water which may remain in some varieties of coal, even after desiccation by free exposure to the air, deserves more attention than it generally receives from metallurgists.

All coal contains a sensible amount of inorganic matter, of which the chief constituents are silica, alumina, lime, and iron. It is this matter which appears as the ashes of coals. Now, admitting that alumina is not an ordinary constituent of plants, it follows that the matter of which the ashes are composed has been derived not merely from the inorganic elements originally existing in the plants from which coal has been produced, but also from an extraneous source. When we consider the conditions under which coal must have been formed, we can be at no loss to understand how such extraneous matter should have been deposited in a coal-field by the agency of water. We have only to inspect a coal-seam to have ocular and positive proof of the interstratification of coal and earthy matter such as shale and sandstone. In illustration, we may take the familiar but extreme case of blackband ironstone. This ironstone consists essentially of carbonate of iron intimately mixed with coal. If further proof were needed of the admixture of coal with such extraneous matter, it is furnished conclusively by the results of Taylor, who has analysed the matter forming the bed and the roof of a coal-seam at Newcastle (*Buddle's Hartley* and Blaydon Burn Colliery), as well as the ashes of the intervening coal. The analyses are as follow:—

	1.	2.	3.	4.	5.
Silica	62·44	59·56	64·21	56·51	58·99
Alumina	31·22	12·19	28·78	31·89	26·19
Sesquioxide of iron	2·26	15·96	2·27	...	5·14
Protoxide of iron	...	...	...	7·04	5·11
Lime	0·75	9·99	1·34	1·69	0·67
Magnesia	0·85	1·13	1·12	0·85	1·54
Potass	2·48	1·17	2·28	1·38	2·34
Soda	...	...	...	0·61	...
	100·00	100·00	100·00	99·97	99·98

1. *Fire-clay*, on which the coal rests, after subtraction of 10·5 per cent. of water and 0·44 per cent. of chloride of sodium and sulphate of soda.

2. Ashes of *good coal* (1·36 per cent.), after subtraction of 8·2 per cent. of sulphuric acid. The source of the sulphuric acid will be explained in the sequel. 3. Ashes of the *coarse coal* (16·9 per cent.), after subtraction of the sulphuric acid. 4. *Bituminous shale*, after subtraction of 39·35 per cent. of organic matter. 5. *Bluish shale*, after subtraction of 11 per cent. of water.

Ashes of coal.—In the choice of coal, attention should be directed to the *nature* as well as the *proportion* of the ashes which it may yield. The proportion may be so great as to lessen its value in a very material degree, or even to render it useless as a fuel for many purposes. It may be determined by incineration at a red heat in a platinum or porcelain crucible. The process may be conveniently conducted either over an air-gas flame or in a muffle. In respect to the *nature* of the ashes, the amount of oxide of iron is a point of chief importance. Iron pyrites is present in all coal, in which it may occur either invisibly diffused through the mass,—in visible laminæ,—or in layers and nodules, sometimes of considerable size. The spontaneous combustion of coal in coal-mines appears to be due, in part at least, if not wholly, to the heat developed by the oxidation of intermixed pyrites by atmospheric air. When some kinds of coal are left exposed to the air, yellow spots will eventually appear here and there on the surface, which consist of basic sulphate of sesquioxide of iron (misy) derived from the oxidation of pyrites. At first, sulphate of protoxide is formed, of which the quantity is occasionally so great as to cause complete disintegration of the coal. The water which flows from coal-mines frequently contains in solution sufficient sulphate of iron to communicate a strong chalybeate taste. Such a solution rapidly corrodes iron boilers, and, by free exposure to the atmosphere, will deposit a yellow-brown ochreous compound of basic sulphate of sesquioxide of iron. Shale, which consists essentially of silicate of alumina, is generally present in coal in a greater or less degree, as will appear from the analyses of the ashes of coal; and when it is in contact with iron pyrites in process of oxidation by exposure to the air, it may give rise to the formation of iron-alum in white asbestiform fibres. The formula of this beautiful substance is $\mathrm{FeO, SO^3+Al^2O^3, 3SO^3+24HO}$.

The iron pyrites in coal will be represented in the ashes by an equivalent amount of sesquioxide of iron, provided incineration be perfect; and generally by far the greater portion of the oxide of iron in the ashes is derived from pyrites. The proportion of that oxide may be sufficient to give a red colour to the ashes, or it may not be sufficient to cause sensible coloration; hence the distinction between *red* and *white ash* coals. The intensity of the red colour, taken in connection with the amount of ashes in coal, may serve as an indication of the proportion of sulphur existing in the state of pyrites. When a coal contains pyrites in considerable quantity, especially in the state of nodules, it may speedily destroy the fire-bars of a furnace. In one instance in which a highly pyritic coal was employed in a reverberatory furnace, I observed ferruginous masses depending like stalactites from the lower surface of the bars, which were rapidly corroded in consequence. When the ashes sinter together or melt, they form a more or less vitrified mass termed *clinker*, which may accumulate upon the bars so as greatly to impede the passage of air between them, and, as a consequence, lower the temperature of the furnace. Moreover, when the bars are covered with a firmly-adherent bed of clinker, and are no longer cooled by a continuous current of cold air, they may soon become heated and destroyed by oxidation. Now, the presence of much oxide of iron in the ashes may, in a certain degree, increase their fusibility, and so tend to induce the evil arising from the formation of an impervious bed of clinker. In this case a greater expenditure of manual labour would be required in removing clinkers, or, as it is termed, *clinkering* the grate. But sometimes a bed of clinker is expressly formed, and made to serve an important purpose. Thus, in furnaces in South Wales such a bed is ingeniously used as a substitute for a grate, on which small and inferior coal may be consumed, which could not be otherwise profitably applied. The bed is allowed to become 12 or 20 inches thick, and requires to be supported only by a few bars, which, being far removed from the fuel, remain comparatively cool. It is kept broken up, so that a sufficient quantity of air may traverse it; and, in proportion as it accumulates above, it is cut away underneath by means of a crowbar with a cutting edge and a heavy hammer. This operation is termed *breaking the grate*. However, as a rule, the less a coal clinkers the better for most purposes, and for none more so than boiler-furnaces. Irrespective of the formation of clinker, a certain amount of inorganic matter in coal is sometimes beneficial in preventing the fire from too rapidly collapsing, as it were, in the furnace. On this account a kind of coal called *brasils*, which occurs in the middle of the ten-yard coal in South Staffordshire, is preferred for reverberatory furnaces by some smelters in Birmingham.

Errors in analysis of coal.—When coal contains much inorganic matter, especially iron pyrites, the usual method of calculating its composition from the data obtained in the process of organic analysis may be erroneous in a sensible degree. The ashes left by incineration are estimated as inorganic matter, and the proportion of *oxygen* is found by subtracting the sum of the carbon, hydrogen, nitrogen, and ashes from the amount of dry coal subjected to analysis. By incineration the iron of the pyrites is converted into sesquioxide, and the sulphur, in a greater or less degree, into sulphuric acid, which may remain in combination with any base in the ashes—such as lime—capable of forming a sulphate not decomposable at a red-heat. Supposing the whole of the sulphuric acid to be thus retained in the ashes, for 1 part of iron pyrites there would be an increase of 1 due to oxygen derived from the air during incineration. The whole amount of this error, provided no correction be made, would fall upon the oxygen. It is not asserted that the whole of the sulphur is actually converted into sulphuric acid and retained in the ashes, but that a considerable portion of a stable sulphate may be produced during incineration will appear from analyses of coal in the sequel. It is certain that the alumina in the ashes must in great measure exist in combination with silica as clay; but clay holds water in combination which cannot be expelled except at a temperature far more than sufficient to decompose coal. Hence, during the process of organic analysis water may be evolved from the clay present in coal, and so occasion an error of excess in the determination of the hydrogen. This source of error has been pointed out by Regnault. Carbonate of lime is sometimes present in coal in very appreciable quantity, in which case carbonic acid would be evolved during the analysis, and so an error of excess would be caused in the determination of the carbon. M. de Marsilly has observed that, however pure a piece of coal may be, and however homogeneous it may appear to the eye, its different parts do not yield the same proportion of fixed residue by incineration; and the same is true in respect to the proportion of coke obtained by the calcination of different fragments of the same lump of coal. Hence, in every case, the proportion of ash and coke should be determined by operating upon an average sample taken from the powder of the coal.

Lignites.—The synonyms are brown coal, bituminous wood, and pitch-coal of Werner (Pechkohle). Geologists apply the term lignite only to those carbonaceous minerals which occur in deposits of later date than the true Coal Measures; and yet these minerals may occasionally not be distinguishable, either in physical characters or chemical composition, from undoubted bituminous coal. However, the cases in which lignites thus resemble bituminous coal are exceptional. Lignites seem generally to differ from other kinds of coal in the *large proportion of water* which they retain, even after free exposure to the atmosphere at the ordinary temperature. They appear to pass by insensible gradations into bituminous coal; and at present it seems impossible to construct a definition, except on geological grounds, which shall be characteristic of lignites alone, to the exclusion of all other kinds of coal. For the sake of convenience, some varieties of coal which occur in formations posterior to the Coal Measures, and which approximate closely to, if they are not identical with, certain kinds of bituminous coal, will be classed among the lignites proper. Moreover, an illustration will thus be afforded that true coal, so far as relates to composition and external characters, is not confined to the Coal Measures.

Lignite is either wood-like in structure, earthy, or compact; fracture conchoidal, wood-like, or uneven; colour of various shades of brown, brown-black, or black; lustre dull, shining or fatty; specific gravity generally ranges from 1·2 to 1·4; in composition it approaches nearer to wood than bituminous coal, and is specially distinguished from other kinds of coal in retaining a large proportion—from 15 to 20 per cent. or more—of water, even after desiccation by long and free exposure to the atmosphere at the ordinary temperature. Lignites are generally non-caking,—that is, the powder of lignite, when heated to redness in a close vessel, does not yield a coherent coke. The term lignite is restricted by some persons to such varieties as manifestly present the appearance of woody tissue, the term *brown coal* being applied to all other varieties. Brown coal is the term at present used by the Germans as including all varieties, whether woody, earthy, or compact.—"*Metallurgy*," *by John Percy, M.D., F.R.S.*

Fossil Plants in Coal-Beds of Arkansas.

1. Alethopteris nervosa, Brgt.
2. Alethopteris Owenii, Sp. nov.
3. Annularia sphenophylloides, Ung.
4. Asterophyllites equisetiformis, Sternb.
5. Asterophyllites gracilis, Sp. nov.
6. Blattina venusta, Sp. nov.
7. Bornia? Sp. nov.
8. Calamites approximatus, Sternb.
9. Calamites cruciatus, Brgt.
10. Calamites undulatus, Sternb.
11. Cardiocarpon affine, Sp. nov.
12. Cardiocarpon ingens, Sp. nov.
13. Carpolithes platimarginatus, Lsqx.
14. Cordaites borassifolia, Ung.
15. Cyclopteris (broken specimen).
16. Diplotegium truncatum, Sp. nov.
17. Halonia pulchella, Sp. nov.
18. Hymenophyllites flexicaulis, Sp. nov.
19. Hymenophyllites, Sp. nov.
20. Lepidodendron diplotegiodes, Sp. nov.
21. Lepidodendron modulatum, Lsqx.
22. Lepidodendron vestitum, Lsqx.
23. Lepidophloios irregulare, Sp. n.
24. Lepidophyllum brevifolium, Lsqx.
25. Lepidophyllum lanceolatum, Brgt.
26. Lepidophyllum, leaves of Lepidodendron.
27. Lepidophyllum majus, Brgt.
28. Neuropteris fimbriata, Lsqx.
29. Neuropteris hirsuta, Lsqx.
30. Neuropteris tenuifolia, Brgt.
31. Neuropteris vermicularis, Lsqx.
32. Odontopteris intermedia, Sp. nov.
33. Pecopteris villosa? Brgt.
34. Rhabdocarpos minutus, Sp. nov.
35. Rhizolithes palmatifida, Sp. nov.
36. Sigillaria reticulata, Sp. nov.

37. Sigillaria, Spec. nov.
38. Sphenophyllum bifurcatum, Sp. nov.
39. Sphenophyllum longifolium, Gutb.
40. Sphenophyllum Schlotheimii, St.
41. Sphenopteris dilatata, Sp. nov.
42. Sphenopteris decipiens, Lsqx.
43. Sphenopteris Gutbieriana, Germ.
44. Sphenopteris obtusiloba, Brgt.
45. Staphyllopteris stellata, Sp. nov
46. Stigmaria ficoides, Brgt.
47. Stigmaria irregularis, Lsqx.
48. Stigmatocanna?

From a view of this table, the following conclusions can be drawn. That of forty-eight enumerated species, eighteen are new, and consequently have not been found above the Millstone Grit. Two more, represented by broken specimens, are perhaps new also. and thus 26 to 28 species of the Arkansas coal have been found before in strata of coal above the Conglomerate formation at other places in the United States coal-fields. I doubt not that if we had had a whole day to spend at Male's coal-bank instead of an hour, we would, with the assistance of Mr Cox, have collected at least a dozen other new species. But the number of old and already known species would have been greater also, since in a hurried examination I could note only the most marked species which were seen. Therefore the coal plants of the Male's bank may be considered as presenting in a fair average the proportion of old and new species of plants pertaining to the coal-beds below the Millstone Grit. Admitting this, I do not think that this proportion of new species of plants of the Arkansas Coal Measures authorises a separation of these Measures from the beds above the Conglomerate ; permitting the distinction of another name (that of *false coal-measures*), as if they were a peculiar formation.

New discoveries of fossil plants by the Geological State Survey of Illinois show the proportion of large trees increasing as far down as below the Upper Archimedes Limestone, where a thin bed of coal is sometimes present, as at Fayetteville. Nevertheless, the plants of this low position are still of the same genera as those of the true Coal Measures, and half of them, at least, have the same specific characters. Thus, it is evident that the true Coal Measures descend as low as the Subcarboniferous Limestone, and even can be counted to the second bed of the Archimedes Limestone. Not much coal is formed there, it is true, but it is the beginning, the infancy of the epoch, which, as at the time of its decrepitude and near its end, has the strata of combustible matter scarcely formed and thin.

It is impossible now to establish a close comparison between the strata of the Old Red Sandstone of Pennsylvania and the Subcarboniferous Limestone of the West, which, following the assertion of some geologists, occupy its place. From some data formerly collected, the Red Sandstone of Pennsylvania had very few species, if any, identical with those of the Coal Measures. It is characterised especially by the species of true *Noeggerathia*, which have never been found in connection with the coal, and which I have found in abundance in the red shales immediately underlying the conglomerate formations of Mauch Chunk and Pottsville, and lower still.

It would be even more difficult to compare the distribution of the plants of the Coal Measures and of the New Red Sandstone or Permian overlying them. The Permian is scarcely known in America, and no plants have been found in it. But in Europe, the proportion of the vegetable species common to the Permian and the Coal Measures is no more than eight per cent, while between the Subconglomerate coal and the Coal Measures above the Conglomerate, the proportion of common species is from fifty to fifty-five. Moreover, with the appearance of the

Permian, a number of entirely different typical forms, mostly Coniferæ (Araucarites, Walchia, Pinites, &c.), appear at once; and these forms having no relation whatever to the genera of plants of the Coal measures indicate a new epoch in the vegetation. Thus it is certain, that if we should separate, as some geologists have done, the Subconglomerate coal as a peculiar formation, we would do it against the general laws of distribution of the species, and would be forced to consider each peculiar bed of coal as a separate formation, or rather as an epoch.

The other conclusions taken from the examination of the table are in favour of the horizontal identity of all the coal strata of Arkansas, the apparent difference in their species resulting from the small number of fossil plants which have been found at some localities. Thus the coal of James' Fork of Poteau where, after Male's coal-bank, the largest number of fossil plants were seen, has, in twenty-five species, ten species in common with Male's coal, some of which are new and apparently truly characteristic of the subconglomeratic coal. Of ten species collected at Jenny Lind coal-bank, eight were seen also at the James' Fork of Poteau. Seven of the eight species of Lee Creek coal have been found also at Male's, and of eleven fossil plants found in the shales at Frog Bayou, seven belong also to Male's coal-bank. Taking into consideration the insufficiency of the researches and the distance of the coal-banks where the plants were found, it is easily admitted that this approximate identity of species shows with great probability, if not with certainty, that the coal-banks or strata reported above are to be placed on the same geological horizon.

The Lignite formation is easily distinguished from the Coal Measures, as well by its distribution, its geological position, the chemical compounds of its combustible matter, as by the plants by which it is accompanied. From the few data which have been collected in Arkansas it appears that the lignites of that State are found generally near the base of the Tertiary measures. They have been formed by an accidental deposition of a certain quantity of wood, apparently transported by rivers or some other agency, or even, perhaps, are composed of the heaped remains of trees which grew in marshes and swamps at the place where beds of lignites are now found. The areas which they cover with strata of combustible matter is extremely variable. Sometimes they extend themselves for hundreds of miles, preserving a constant horizon; sometimes they have only a few feet in diameter, and appear either thin or like a broken and heaped compound of combustible black matter, irregularly placed at various horizons in the same vicinity. Beds of Lignites are generally intermixed with clay or sand. Their overlying strata are not shales, but mostly soft, black or yellow plastic clay or sand. The numerous remains of plants found in this soft matter are of course decayed, broken, and undistinguishable.

The only bed of Lignites which I had an opportunity of examining in Arkansas is exposed on Little Cypress Creek, Dallas County, on the property of Mr. Watson. It crops out on the nearly perpendicular and much disturbed bank of the creek, is one to two feet thick, sometimes black and a compound of pure combustible matter much softer than stone coal or true coal, sometimes formed of alternate layers of soft clay with bands of black and pure lignite, from one to two inches thick. There are apparently two beds of lignite exposed on this bank. The one, nearly at the top of the bank, is overlaid by one foot of black soft clay covered with about twenty feet of argillaceous sand. The other exposed a little lower down the creek appears separated from the former by nine feet of soft plastic clay without plants. As the bank has been much disturbed by the erosions of its soft parts, which have caused slips and local subidences, it is still possible that there is only one bed of lignite formed there, parts of which have accidentally been broken off and dropped down the declivity of the bank.

In counties where wood is still abundant, beds of tertiary lignites are perhaps, for the present, of no great value. Nevertheless, when the combustible mineral is pure, the amount of carbon which the matter contains is always greater than it is in wood. Following the analysis of two specimens of lignite of Green County, the amount of carbon in the matter is fifty-three to fifty-seven per cent., when the carbon of wood does not amount to more than forty to forty-five per cent. Thus these beds of lignites may become valuable in the future, especially for the navigation of the steamboats on the rivers.

As beds of lignite found in the south-eastern part of Arkansas have been taken sometimes for strata of true mineral coal by persons unacquainted with the distribution of the geological formation, it is well to present in a single table, and for comparison, some of the fossil leaves which are generally found in connection with these beds of recent origin. All the leaves found fossil in the Tertiary, recall forms which we are in the habit of seeing around us on the trees of our time. Most of the genera, even some of the species, are the same. Thus we have with the lignitic formation fossil leaves of the oaks, walnuts, beeches, magnolias, elms, and others; mostly leaves of Dicotyledonous trees, easily recognised by the branching of the veins. On the other hand, the fossil leaves of the true coal are mostly ferns, and the other remains represent the scars on the striæ of the bark of trees of which the form, the direction, and the remarkable regularity is entirely at variance with the rough and irregular surface of the bark of our trees.—*Geological Reconnoissance of Arkansas*, 1859 and 1860, *by David Dale Owen.*

Sub-Himalayan Rocks.—Pointing out briefly how, from the abundance of the fossil evidence, the Siwalik strata had at once taken their position in the acknowledged series of rock-formations, while very little indeed was known of their physical structure; and how at the same time other groups of Indian rocks, whose statigraphical relations were well known, had not as yet been accurately placed in the general succession, owing to the absence of such fossil evidence, Mr Medlicott stated that his own attention had been specially directed to investigating the physical structure of the district referred to, not to the collection of fossils.

The rocks included are the Siwalik and the Nummulitic groups, and a series of schistose rocks older than both these, and lying to the north of them. The present notice was principally concerned with the newer groups (the Upper Nummulitic and the Siwaliks), the separation of which from the lower and more indurated underlying strata is generally well defined.

Up to the present time our knowledge of these groups was as follows. The most connected sketch hitherto given is by Captain R. Strachey (Quar. Jour. Geol. Soc. London, vol. vii. p. 292, 1851). This paper chiefly related to the rocks of the higher ridges and of Thibet, but the author refers also to the fossiliferous rocks at foot of the range. The section, given by Captain Strachey, passing through Nainee Tal, shows but a very bad development of the Siwalik rocks, and he could nowhere "find or hear of any fossil remains among them." He assumes them, however, to be the representative of the rocks near Dehra. He then proceeds to notice a series of sandstones, with occasional small seams of lignite, and imperfect vegetable impressions, and with beds of marl. and occasionally salt-springs, which form the northern boundaries of the longitudinal valleys, or dúns, the connection of which with the outer Siwaliks he could not trace, but conjectured that there must be great faults. Suggestions were thrown out that these might be of the European Saliferous age, or possibly the extension of the strata containing rock salt which are found farther to the west in the salt range and in the hill district of Mundee. It was also suggested, as possible, that they might have some connection with the fossiliferous beds near Subathoo. In 1853 a brief notice of the rocks about Subathoo, by Major Vicary, appeared (Quar. Jour. Geol. Soc. London, vol. ix. p. 70). In this paper the author noticed the true Siwalik rocks, south of the Pinjore Dun, and also a sandstone not unlike that of the Siwaliks, in the north of the dún in which he had sought for fossils in vain. The connection of this with the outer Siwaliks is concealed. North of this we meet with confused strata of variegated shales, also unfossiliferous. On the ridge of Kussowlie, and beyond it to Subathoo, the fossiliferous rocks of the Nummulitic period show, associated with variegated rocks, &c. These are made subjacent to the fossiliferous strata. All these groups Major Vicary separates from the Simla series by a great fault. Regarding the age of these older and inner rocks, neither Major Vicary nor Captain Strachey offer any conjecture.

In M. D'Archiac's valuable treatise on the Nummulitic fossils of India, Major Vicary's section is copied, and he is quoted as the authority for other statements. In these there is an important discrepancy or error which must be noticed. M. D'Archiac speaks, in the most unequivocal manner (pp. 175, 176), of mammaliferous strata, representatives of the Siwalik formation, about Subathoo, and there overlying the Nummulitic rocks. Inasmuch as Mr. Medlicott's own researches had pointed out that the strict limitation of those fossils to the "Siwalik hills" is one of the most interesting facts in the geology of the district, he devoted repeated examination and inquiry on the spot to investigating these statements, but he could find no trace of such fossils; nor could he reconcile M. D'Archiac's statements with Major Vicary's published account. Possibly the explanation of the difference is this: Major Vicary does mention fossil bones at and near to Subathoo: he says, "Saurian remains are, however, plentiful; I am not so sure with respect to mammalian remains, but, as the specimens are in good hands, I hope soon to settle that point." These remains, however, he in every case describes as occurring in blue or red shales alternating with or underlying Nummulitic strata. Without in the least questioning Professor Owen's skill in identifying genera from obscure remains, Mr Medlicott was forced to think Major Vicary far too experienced and too intelligent a collector, to have failed in recognising as mammalian such abundant remains as are mentioned by M. D'Archiac —"Elephas, equus, bos, cervus, &c., des debris de dent d'un elephant mastodontoide," and other similar statements. A clue to the explanation is to be found in M. D'Archiac's own words—that the sands, gravels, and conglomerates with bones of large mammalia, rest quite conformably on the Nummulitic beds near Subathoo (p .176). Now, there is not even an allusion to such rocks by Major Vicary; on the contrary he says, "The blue shale, on which the quarter-guard of Subathoo stands, contains fossil bones in abundance," and so in other cases. In truth, there are no such rocks at Subathoo as those spoken of by M. D'Archiac. Such rocks are unquestionably the common habitat of Siwalik fossils, and it is not improbable that, in consequence of original deficient labelling of specimens, and possibly of subsequent intermingling, or, in consequence of a misunderstanding of written or verbal communications, some true Siwalik fossils were mistaken as coming from near Subathoo.

Mr. Medlicott's own researches, extending over a direct distance of more than two hundred and fifty miles, from the parallel of Nainee Tal to beyond the Sutlej, led him to expand considerably the series of rocks which were known to occur within these limits. This, for the present, could be most conveniently done under the two groups already known, viz the Nummulitic and the Siwalik. Of these groups the latter is continuous beyond the limits of the area examined; the former are much more irregular. The Upper Nummulitic group does not even reach the Jumna on the east; while on the west also its continuity is interrupted, though not permanently.

Thus the connection suggested in Captain Strachey's paper and map between the lignite sandstone, N. of the Kotah Dún, and the fossiliferous sandstone of Subathoo, is not established. The Kotah Dún rocks really correspond to the Siwalik-like sandstone, N. of Pinjore Dún, in Major Vicary's section.

Between the two groups the most decided physical separation exists, a fault of enormous throw, amounting to the entire thickness of the two series, cutting off the Siwalik group from all to the north of it. To the east of the river Jumna this great fault runs at a variable elevation along the flank of the hills lying to the north of the dúns; the rocks, in junction on the north, being the limestones, slates, and grits of the Lower Nummulitics and of the undetermined subjacent rocks—the Masuri or Nainee Tal series; while to the west of the Jumna, the rocks in junction are generally these same schistose rocks, but often, especially at higher levels, the Upper Nummulitic series.

North of this fault there is not so decided a boundary; the junction of the Upper Nummulitic series with the slaty series, lying to the north of it, is not (though so represented) a great fault. There is, undoubtedly, considerable local faulting; but, generally, the junction appears to be the original contact of deposition between unconformable strata. The Upper Nummulitics, in fact, seem to rest upon a ledge of the slaty rocks, upon a denuded surface of which they had been deposited.

There is a most marked geological separation to be made in the series spoken of as Nummulitic, upper and lower. Of the lower group, the best and least disturbed section is at the Król mountain on the new road to Simla. At this locality there is a well-defined series (from 500 to 800 feet) of hard limestones with variegated slaty shales and grits, which may be called the Król group. It rests, unconformably, upon a great thickness of very thin bedded slaty shales and gritty flags, often highly carbonaceous and black, which may or may not prove to be a member of the lower Nummulitic series.

The upper sub-division of the Nummulitics is best seen near Subathoo, and gives three sub-groups in descending order:—

1st. Sandy—hard sandstones largely predominate; well exposed in Kussowli hill. In this group (at Kussowli and elsewhere) some well-preserved leaves and stems of trees, and other remains of terrestrial vegetation, have been found.

2d. Sandy-argillaceous—lumpy sandy red clays. These are characteristically seen in flanks of Dugshai hill.

3d. Calcareo-argillaceous—well seen near Subathoo. These are all connected by conformity in stratification, and by transition in mineral character, and form one continuous sequence. They may be called the *Subathoo group.*

In rocks so contorted it is difficult to estimate thickness, but 1800 to 2000 feet may be given as the minimum.

All fossils hitherto procured have been from the lower half of this series, as seen near Subathoo.

The beds of this upper or Subathoo group are often found folded into the contortions of the Król group and the subjacent slates—Król and Bój mountains, &c.

This Subathoo group is entirely distinct, as shown, from the band of limestones and slaty clays long known to extend along the southern border of the western Himalayas. It does not appear to extend to the east of the Jumna, at least no trace of it is seen between the Jumna and Nainee Tal.

The separation we have made here from stratigraphical considerations was in a manner anticipated by D'Archiac from a consideration of the fossil evidence alone; at least he pointed out the entire distinctness of the organic remains of Subathoo as compared with those of the Punjab, of Scinde, of Beloochistan, and of Cutch (p. 175). But in the concluding section of this description (p. 179) where reasoning on the very uncertain observations of others, he is far from correct in stating that no appreciable unconformity could be observed between the two, or indeed between the Nummulitic strata generally and the overlying Siwalik series.

The evidence for supposing the Król group, as given above, to be also of Nummulitic age, is not perfectly conclusive. Mr A. Schlagintweit has announced the discovery of Foraminifera in the neighbourhood of Nainee Tal, "identical with those which accompany the Eocene Nummulitic formation," and those rocks at Nainee Tal are considered by Mr Medlicott to be the true representatives of the Król beds; but independently of this, the conclusion was arrived at from observations in the salt range, and in the Himalayas of Huzara and Poonch.

There is a great similarity in the section about Murree and north of Kotlee in the Kashmir territory, to that at Subathoo. Three or four miles north of Kotlee there is a stony rib of hard limestone, with an E.S.E. direction; on both sides of this are brown clays and lumpy earthy limestone of the same character as the Subathoo rocks, succeeded by a great thickness of red clays and hard limestones; in fact, the series called above the Upper Nummulitic. These rocks are noticed by Mr Schlagintweit, "To the south of Kashmir a zone of Nummulitic marls and of sandstones, of thirty-nine to fifty miles broad, borders the Himalaya towards the plains of India." The relations of this series to the massive limestone ridge are precisely the same as with the Król limestone; the ridge at Dundelee being altogether analogous to the rib thrust through the Nummulitic strata at Dihur on the Sutlej; the resemblance lithologically is also perfect. Again, Murree stands on a mountain of red clays and sandstones; the Moochipora ridge to the N. and N.W. of it is of the hard limestone, and along the junction Nummulitic rocks, identical with those at Subathoo, are easily traceable, although not well developed. In this hard sub-crystalline, and generally unfossiliferous limestone of the Moochipora ridge, Nummulites have been found, as already noticed by Dr Fleming (Quar. Journ. Geol. Soc. London, 1853, p. 200). On passing to the salt range, this Subathoo series was found to be entirely wanting, although so largely developed to the north. In the salt range, the thick soft sandstones and variegated clays of the Siwalik formation rest directly on the clear Nummulitic limestones, as noticed by Dr Fleming; the very junction layers containing only rolled Nummulites. But there is nothing, at least in the east of the range, to *represent the Subathoo group*. There is nothing, either, to suggest the idea that these can be assimilated to the salt range Nummulitic rocks; on the contrary, all stratigraphical and mineral affinities of the Subathoo group are with the Siwalik type rather than with that of the salt range Nummulitic strata. These latter appeared to be more probably the representatives of the great limestone deposits which were found all along unconformably subjacent to the Subathoo group. These on the main range of hills have been more developed than on the salt range; they have also been much more indurated, and very much more disturbed, but are supposed to be one and the same.

While, therefore, in deference to its fossils, the Subathoo group has been classed as Upper Nummulitic, it must be remembered that, considered stratigraphically, it should be considered as the commencement of the Siwalik conditions of deposition.

The northern extension in the outer Himalayas of this Lower Nummulitic series, the Król group and the subjacent slaty schists, has not been as yet worked out. The section through Simla to Kotgurh (forty miles N.E. of the Król) presents no contrasting junctions like those already described in the outermost zone; there are several lines of special crushing and contortion, but they do not introduce new rocks. The degree of disturbance is not on the whole increased, and the increase of metamorphism is very gradual and strangely capricious. Thus at Simla highly schistose rocks overlie smooth slaty grits. Indeed, it seems highly probable that the rocks of this section will be identified with, or found closely connected with, the Król series. Simla stands on the northern rise of a great synclinal bend, of which the Tara-Devi hill is the southern rise; at Jatog, the western spur of the Simla ridge, there are some hard cherty limestones that may well be the Król limestone; the thin-bedded slaty grits in the glen below Simla are very similar to the series subjacent to the Król group; among all these are frequent reappearances of the carbonaceous (graphitic) ingredient that is so well developed on the S.W. base of the Król hill.

Besides their greater induration, these Lower Nummulitic rocks differ from the Subathoo group in the presence of trap rocks. Towards the east these are very abundant; west of the Jumna, trap rocks are scarce.

Siwaliks.—Little has been added to our knowledge of these rocks since Captain (now Colonel Sir Proby) Cautley described them in 1836. (Trans. Geol Soc. London, vol. v. p. 267.) Indeed, even the suggestions thrown out by him have not been followed up further. He pointed out that the connection between the subordinate range and the higher hills could be traced in the Nahun district, where the two were continuous without any intervening dún, yet none of the many subsequent fossil-seekers seem to have adopted the hint.

Captain Cautley roughly divided the whole series into three groups without defining the extent of each: 1st. the lowest, coarse clays containing reptilian and mammalian remains; 2d, blue marl with freshwater shells; and 3d. sandstones and conglomerates, which were the chief source of the larger mammalian remains. The true value, or even the correctness of these sub-divisions Mr. Medlicott was not prepared to establish, but several facts point to a much wider difference between the groups than Cautley supposed. Considerable faulting exists, and the rocks brought into junction by these faults suggest some new facts. In the valley north of Nahun, thick soft grey lignite sandstones, with subordinate beds of lumpy gritty red clay, are, by the great fault already noticed, brought into contact with a crushed rock of the Subathoo Nummulitic strata, and of the infra-Król shales. South of Nahun, where the Markunda extricates itself from the higher hills, the lower beds of the same series, in which clay predominates, are in junction, along a fault, with thick shingle beds of the outer Siwaliks, the topmost beds of the whole series, and in which the lower hills commence. The Nahun rock is continuous along the hills bounding the north side of the dún both to east and west. It is the lignite sandstone, the same as that noticed by Captain Strachey as occurring below Nainee Tal (from this the Dechouree iron-works now derive their ore), and it is also the Siwalik-like sandstone noted by Major Vicary, north of the Pinjore Dún. Captain Cautley always considered these Nahun rocks as belonging to the Siwalik formation, but it does not appear that he identified them with the sandstones north of the dún.

The continuity of this fault renders it probable that its throw is very considerable. To attain anything like an exact estimate of this, the position of the Nahun beds in the general series must be ascertained. This is by no means an easy question. And though not prepared to settle the point definitely, it may be useful to show how the matter stands.

Captain Cautley referred the Nahun rocks to the *lowest* member of his threefold division of the Siwaliks. Now, large mammalian remains are found in the earthy sand and boulder-beds immediately to the south of the fault—thus the top and the bottom beds of the entire series, so far as we know them, are here brought into contact. But, further, the boulders in this outer rock, at the junction, are boulders of the lignite sandstone of Nahun hill; there is no other rock in section to the north that could have yielded them. And this fact would seem to involve either a want of strict correspondence between the Nahun hill beds, and any others in the section to the south of them, or else a total break of conformable sequence in that section. A much more careful examination of fossils and of the strata, than a preliminary survey would warrant, will be required to decide this.

This raises a question as to the successive deposition and upheaval of great banks of these Siwalik strata, which again recurs in the west. It has long been noticed, that there was a great expansion of the Siwalik area in the west, commencing just beyond Kalka and Kassowli. It is occasioned by a curve in the great boundary fault, which here alters its direction to about 15° W. of N.; while the outer line of the Siwalik hills preserves nearly its former direction. In Mr. Greenough's map the sharpness of change in the boundary about Belaspur is exaggerated both by inaccuracies in position of localities and because he includes the Subathoo, or Upper Nummulitic group, the inner or northern boundary of which is much more irregular than the main fault which separates this group from the Siwalik series.

Now, the Siwalik rocks occupy this increased area, not by the extension of the strata already noticed, but by the successive introduction, by faults, of other bands of rock not strictly identifiable with the outer Siwaliks. Even at the Sutlej there are two such bands between the Nahun ridge and the main fault, as seen near Belaspur.

It is not intended to state that our knowledge of the existence and distribution of fossils in these rocks is conclusive; but, so far as known, with the single exception of the discovery by Lieutenant (now Colonel) Durand of fossils near Nahun, there is *no known instance of fossils being found out of the first zone of these rocks—the Siwaliks proper.*

If we attempt to base our inferences upon lithological grounds from the composition and texture of the strata, in a continuous section like this, we must include the Upper Nummulitic group, for, as already stated, it has, in these respects, very marked affinities with the Siwalik series. Many of the lumpy red clays of the Dugshai group are not distinguishable in composition or in hardness from the clays of the Upper Siwaliks: the sandstones also of the same group are markedly of the same general type. Each of these bands, then, has affinities with the one on either side of it, and at the same time has irreconcileable contrasts also. The Belaspur conglomerates overlie, with, at least, general conformity, thick red clays and hard sandstones, exactly like the Dugshai group, yet without any intervening beds to represent the Kussowli group; and these conglomerates undoubtedly contain debris of the Nummulitic series. The rocks south of the Gumber fault are very similar to the Belaspur band, and the bottom strata are of an intermediate type between the Dugshai and the Lower Siwalik strata, being in fact with difficulty distinguishable from the rocks of the Nahun range, with which they are in contact. And lastly, we have the Nahun rocks which are lithologically undistinguishable from the lower strata of the Siwalik hills, while the upper strata of these same hills contain boulders of these Nahun rocks.

All these facts seem compatible only with a long continued, and generally contemporaneous process of upheaval, denudation, and deposition, under conditions commencing with the Upper Nummulitic rocks. This conclusion is entirely at variance with the premature generalisation at which Mr D'Archiac arrived.

In conclusion, the importance of carefully labelling fossils and distinguishing their localities cannot be too strongly insisted on.—*Henry B. Medlicott in Journal of the Asiatic Society of Bengal.*

Ichthyosaurus Normanniæ.—This is a new fossil reptile, which has been found by M. A. Valenciennes, in the Kimmeridge clay of Bleville, to the north of Cape le Heve, near Havre. It differs from the Ichthyosaurus Platyodon of Lyme Regis, markedly in the form of the basilar process of the occipital bone.—*Comptes Rendus, Dec.* 2, 1861.

BOTANY.

Umbelliferæ of Australia and Tasmania. By Dr FERDINAND MUELLER.—Of the numerous paradoxical plants which characterise the Flora of Australia to such a great extent, those of the Umbelliferæ are not the least interesting; and I beg to review briefly on this occasion the various members of this order, which, through the exertions of many a naturalist, became successively known from Australia and Van Diemen's Land.

In Labillardière's "*Novæ Hollandiæ Plantarum Specimen*" (published in 1804), we meet with the first account of the curious genus *Actinotus.* He describes and figures also *Daucus brachiatus*, Sieber (under the name *Scandix glochidiata*), *Apium prostratum* (the native celery), *Eryngium vesiculosum*, and three species of *Trachymene* as *Azorellas*, to which genus, indeed, they are closely allied. In 1805 a second species of *Actinotus* from New South Wales was defined by Sir James Smith with the original one, under the name of *Eriocalia*, but it was reduced to the older genus of Labillardière by the illustrious Robert Brown, in his Appendix to Captain Flinders' Voyage (1814). To Rudge we owe in a paper issued by the Linnean Society of London (1811), the proper definitions of the genera *Trachymene* and *Xanthosia*, and Sprengel, Sieber, and De Candolle added to the former genus, Cavanilles having previously referred one species to *Azorella.* Achille Richard added (in 1820) to our knowledge of these plants various species of *Hydrocotyle*, principally supplied by Robert Brown; and Allan Cunningham characterised in Field's Geographical Memoirs of New South Wales (1825) his *Eryngium ovinum.* The invaluable "Prodromus" of De Candolle brings in the fourth volume (published in 1830) important additions; the genera *Dimetopia* and *Astrotricha* are here for the first time distinguished, and new species are added to *Hydrocotyle, Trachymene, Xanthosia*, and *Eryngium*; and *Helosciadium lephtophyllum* is shown to be an Australian plant; Sir William Hooker having previously given in the "Botanical Magazine" (t. 2875) publicity to two species of De Candolle's genus *Didiscus.* From the collections of Bauer, Cunningham, and Baron Huegel, new contributions were made to the Australian *Umbelliferæ* by the labours of Bentham, incorporated in the "*Enumeratio Plantarum Novæ Hollandiæ Austro-occidentalis*" of Huegel (1837), by which the genera *Hydrocotyle, Didiscus, Trachymene, Leucolæna* or *Xanthosia, Astrotricha* and *Actinotus* became augmented. The Australian species of *Caldasia* (*Caldasia eriopoda* of De Candolle's "Prodromus"), a plant which exhibits the most extraordinary varieties, changed its preoccupied generic name into *Oreomyrrhis* in Endlicher's celebrated "*Genera Plantarum*" (1840); *Pentapeltis*, previously (1857) published as *Leucolæna* by Hooker, and afterwards elevated by Bunge to generic rank, forms here a sub-genus; whilst *Cesatia*, a genus seemingly near to *Didiscus*, received its characteristics by the same author in the Annals of the Vienna Museum. In the important work, edited 1845 by Lehmann, on the Plants of Preiss from Western Australia, a work so replete with novelties, Bunge made us acquainted not only with new *Hydrocotyles*, *Trachymenes*, and *Xanthosias*, and with two *Eryngiums*, perhaps also new, but he discriminates also the genera *Schœnolæna* and *Platysace*, and unites *Pritzelia* of Walper to *Dimetopia*. Mr Ronald Gunn's and Dr Milligan's zealous investigations of the Tasmanian Flora enabled Dr Joseph Hooker to elucidate with his usual skill the new genera *Hemiphues*, *Diplaspis*, and *Microsciadium* in the sixth volume of the "London Journal of Botany" (1847), together with new Tasmanian *Hydrocotyles*; the same famous botanist having introduced *Didiscus humilis* and *Xanthosia dissecta* into the "*Icones Plantarum*" a while before; and in his admirable Flora of New Zealand he identifies the Australian *Orantzia* with an American species.

In the year 1847 we find proved in Schlechtendal's "*Linnæa*" the existence of the European *Sium angustifolium* in Australia, from specimens sent by Dr Behr; and we observe nearly simultaneously an account of a new *Dimetopia* by Bunge in Schlechtendal's and Mohl's "*Botanische Zeitung*;" two other species of that genus are noted by the same acute botanist the year before in an index of plants cultivated in the Botanic Garden of Dorpat. The next contributions are chiefly from the West Australian collections, prepared by the venerable Drummond, which offered to Turczaninow the opportunity of enriching the system of umbelliferous plants with additional species of *Hydrocotyle*, *Didiscus* (referred by him to *Dimetopia*), *Trachymene*, *Xanthosia*, and *Platysace*, the diagnostics of which appeared in the twenty-second volume of the "*Bulletin de la Société Impériale des Sciences Naturelles de Moscou*," and are reprinted by Walpers in his useful "*Annal. Botan. System.*," a periodical which we regret seeing discontinued after the death of its laborious and ill-supported author,* and which was formerly the principal source of information to botanists abroad, and to travellers who had no direct access to numerous botanical works for which the "*Repertorium*" and the "*Annales*" of Walpers formed a valuable substitute. In the first volume of the latter (issued 1849), we observe the genus *Microsciadium* inserted as *Oschatzia*, since the Hookerian appellation was pre-employed by Boissier for the distinction of a new oriental umbellate.

During the botanical exploration of the colonies of South Australia and Victoria (from 1847 till 1855), it fell to the share of the author of this memoir to disclose new forms of *Hydrocotyle*, *Didiscus*, and *Dimetopia*, to point out the range of the Tasmanian genera *Dichopetalum*, *Oschatzia*, and *Diplaspis*, as far as the alps of the Australian continent; and also the occurrence here of *Pozoa*, *Seseli* and *Aciphylla*, the latter combinable with *Gingidium*, both established simultaneously in Forster's "*Characteres Generum Plantarum*" as early as 1775. Definitions of the last mentioned species are partly given in the twenty-fifth volume of the "*Linnæa*," and partly in the "Transactions of the Philosophical Society of Victoria," and in those of the Victorian Institute. Dr Joseph Hooker refers the genus *Pozoopsis* of the "*Icones Plantarum*," as a second species, to *Diplaspis*, in his "Flora of Tasmania," and states the approximate number of Australian *Umbelliferæ* as 120, from which remark it appears that several plants of this order continued undescribed, although existing in herbaria; and, indeed, several unknown to botanists are mentioned in the works of travellers. Thus, Allan Cunningham speaks of a north-west Australian *Azorella* in the appendix to King's "Intertropical Survey of Australia," as being remarkable for its gigantic herbaceous growth."

---

* This work has been continued by Dr Charles Mueller of Berlin.—[EDIT. *Phil. Jour.*]

The last expedition through the intra-tropical zone of this country, so ably conducted by Mr Augustus Gregory, has but furnished a limited number of plants belonging to *Umbellatæ*; yet, perhaps, even more than might have been expected from the known geographical distribution of this order. As new, I may mention a *Hydrocotyle*, two *Eryngia*, four *Didisci*, and a genus which may be distinguished (as *Platycarpidium*) from *Astrotricha* in deciduous petals, from *Trachymene* in flat and smooth carpels, from *Platysace*, as far as the immature state of the fruit permits me to judge, by the want of vittæ, and from *Didiscus* and most of the allied genera by a tall, shrubby habit, so unusual in this order, and, finally, in a paniculate disposition of its umbels, of which the greater number, notwithstanding their being hermaphroditical, remain perfectly sterile.—*Proceedings of the Royal Society of Tasmania*, vol. iii. part 2.

Formation of Wood.—M. Hétet has continued his researches in regard to the formation of woody tissue. With this view he has examined the development of the wood in *Yucca aloefolia*, *Y. superba*, *Dracæna fragrans*, *D. ferrea*, a species of *Cordyline*, *Aloe aborescens*, *A. pseudo-ferox*, among the monocotyledons; and in *Nerium*, *Ficus*, and more especially *Pircunia* (Phytolacca, L.) among the Dicotyledons. From his experiments he draws the following conclusions: 1. In Dicotyledonous trees of rapid growth, and with much parenchymatous tissue, the most deeply situated cellular zones, and even the medullary canal, can reproduce ligneous bundles and a cortical tissue. 2. Fibrous and vascular bundles are formed wherever there are young and active cells. 3. The experiments lead to conclusions opposed to the views of Petit Thouars and Gaudichaud, that the increase of stems in Dicotyledons takes place by means of descending fibres.—*Comptes Rendus*, Dec. 2, 1851.

"Calluna vulgaris" and "Aira caryophyllea" in the United States.—That America has no heaths is a botanical aphorism. It is understood, however, that an English surveyor, nearly thirty years ago, found *Calluna vulgaris* in the interior of Newfoundland; also that De la Pylaie, still earlier, enumerates it as an inhabitant of that island. But this summer, Mr Jackson Dawson, a young gardener, has brought us specimens and living plants (both flowering stocks and young seedlings) from Tewksbury, Massachusetts, where the plant occurs rather abundantly over about half an acre of rather boggy ground, along with *Andromeda calyculata*, *Azalea viscosa*, *Kalmia angustifolia*, *Gratiola aurea*, &c., apparently as much at home as any of these. The station is about half a mile from the State Almshouse. Certainly this is as unlikely a plant, and as unlikely a place for it to have been introduced by man, either designedly or accidentally, as can well be imagined. From the age of the plants it must have been there for at least a dozen years; indeed, it had been noticed and recognised two years ago by a Scotch farmer of the vicinity, well pleased to place his foot once more upon his native heather. So that even in New England he may say, if he will, as a friend of ours botanically renders the lines—that

Calluna vulgaris this night shall be my bed,
And *Pteris aquilina* the curtain round my head.

It may have been introduced, unlikely as it seems, or we may have to rank this heath with *Scolopendrium vulgare*, *Subularia aquatica*, and *Marsilea quadrifolia*, as species of the Old World, so sparingly represented in the

New, that they are known only at single stations, perhaps late-lingerers rather than new-comers.

Aira caryophyllea has just been detected by W. M. Canby, Esq., in Newcastle County, Delaware, growing very abundantly on a dry piece of ground, rather open, but dotted over with pine trees (*Pinus inops*), and completely surrounded by a forest. It certainly has not been ploughed for ten years, probably not for a much longer time. In company with it was *Polygala Nuttalii*, *Sorghum nutans*, &c., but no clover, *Timothy*, or any of the grasses usually cultivated. Still we suppose this species to have been introduced.—*Professor Asa Gray in "Silliman's Journal,"* Sept. 1861.

CHEMISTRY.

Venom of the Rattlesnake (*Crotalus*).—Dr Mitchell states that the venom of crotalus is an acid fluid, abounding in albuminous matter, and yielding precipitates or coagula with certain reagents. The active element seems to exist in the albuminous compound. Alcohol precipitates all the albuminoid material, innocent as well as poisonous; and heat throws down from diluted venom the bulk of those albuminous compounds in an insoluble and harmless form; the residual water still containing an albuminous acid body (crotaline) uncoagulable by heat, but precipitable by alcohol, and of great poisonous activity. The venom of the rattlesnake has been found to be composed of—

1. An albuminoid body, *Crotaline*, not coagulable by heat of 212°
2. An albuminoid compound coagulable by a temperature of 212° F.
3. A colouring matter, and an undetermined substance, both soluble in alcohol.
4. A trace of fatty matter.
5. Salts, chlorides, and phosphates.

Habits of the Rattlesnake (*Crotalus*) *when in Captivity.*—During a large part of two years, the period which this research has occupied, I was a portion of each day in the room where the reptiles were kept, and consequently observed with care such of their habits as could be studied while they were in confinement. In regard to these I have a few observations to make, before considering their physiology and toxicology.

It is by no means my intention to give a full account of the habits of the Crotalus, since this would involve a great deal of detail which is to be found elsewhere, and which would be foreign to the general purpose of this essay.

The rattlesnake of our Northern States, when at liberty, sometimes lives in the company of his fellows, but more frequently alone. I have had, in a single box, from ten to thirty-five snakes, and have never observed the slightest signs of hostility towards one another. Even when several snakes were suddenly dropped upon their fellows, no attempt was made to annoy the new-comers, while the sudden intrusion of a pigeon or a rabbit was met with ready resentment, whenever the snakes were fresh and in vigorous health.

The habits of rattlesnakes, when in confinement, are singularly inactive. Even in warm weather, when they are least sluggish, they will lie for days together in a knotted mass, occasionally changing their position, and then relapsing into perfect rest. The contrast between this ordinary state of repose, or sluggish movement, and the perilous rapidity of their motion when striking, is most dangerously deceptive. In contrast also with their slow locomotion is the marvellously rapid action of their rattles, which, when annoyed or molested, they will sometimes continue to agitate for hours at a time.

It is the general experience of those who have kept rattlesnakes, that they seldom eat in captivity. I have known a snake to exist for a year without food; and although I have made every effort to tempt my own snakes, I have never seen any one of them disposed to avail itself of food, when placed within its reach, Dumeril states that this is the usual experience in the Garden of Plants, but that at the end of six or eight months they commonly accept food. He also adds that the very young pigeon is the food they are most inclined to eat.

After tempting the snakes with this, as well as with birds, mice, rabbits, &c., and finding the food as often untouched, I finally gave up the attempt, and contented myself with feeding, by force, such of them as seemed feeble and badly nourished. For this purpose, I used milk and insects, which I placed in their throats, while they were properly pinioned. To effect this, the snake was secured, and the lower jaw held in the grasp of a pair of forceps, while a funnel, with a long stem, was thrust down the œsophagus. Into this, insects, such as flies and grasshoppers, were pushed, or milk poured in proper quantity. Yet, even when this precaution of forcible feeding was not employed, the snakes remained healthy, and secreted, as usual, a sufficient amount of venom.

To preserve them, however, in good condition, it is absolutely necessary that they should be frequently supplied with water, especially in hot weather, and when they are about to shed their skins. The free snake is said, in this climate, to shed its cuticle in the month of August. My snakes lost their old integuments at different periods, during the summer. In all cases, the old skin became very dark, as the new one formed beneath it. If, at this time, the snakes were denied access to water, the skin came off in patches. Where water was freely supplied, they entered it eagerly at this period, and not only drank of it, but lay in it for hours together. Under these circumstances, the skin was shed entire —the first gap occurring at the mouth, or near it. Through this opening, the serpent worked its way, and the skin reverting, was turned inside out, as it crawled forth in its new and distinctly-marked outer covering. When the old skin was very loose, this snake's motions were often awkward for a time. It is said to be blind during this period, which is probably true to some extent; since the outer layer of the cornea is shed with the skin, and there must obviously be a time when the old corneal layer lies upon the new formation. It is also said that the fangs are lost at the same time as the skin. In some instances, this was observed to be the case; but whether or not it is a constant occurrence, I am unable to say from personal observation.

It is most probable, as I have elsewhere stated, that not only are the fangs shed when the skin is lost, in summer, but that their loss is a frequent occurrence, like the loss of teeth in certain fish, and takes place at intervals more or less frequent, certainly oftener than once a-year.

A general opinion prevails that, immediately after the loss of the skin, the snakes become most virulent. As they are slothful during the period of change, and strike then with reluctance, if at all, and as the loss of the fang involves, to some extent, the accumulation of poison in the gland cavities, this view may be correct. There is no ground, however, for supposing that the effect of this storing up of the venom would be greater at this period than after a similar amount of accumulation at another time.

After such numerous and long-continued opportunities of observation, it might be supposed that I should be prepared to speak authoritatively, as to the still disputed power of the snake to fascinate small animals. If the power exist at all, it is probable that it would only be made use of when the serpent required its aid to secure food. We have seen that even the most healthy snakes lose their appetite when imprisoned, and beyond this condition, my chances of observation have been limited. Those who are still curious in the matter will find the fullest account of it in the Essay of Dr B. S. Barton. In despite of the learned and ingenious argument of this author, there are not wanting large numbers, who claim to have witnessed, again and again, the exercise of the power of charming on the part of the rattlesnake and black snake. Dr Barton, who does not deny that the appearance of fascination has been often observed, explains it by supposing that in these cases the parent bird, alarmed at the near approach of danger to her nest of young, hovers anxiously about the snake, as she would about any other cause of danger, and thus sometimes falls a victim to her maternal anxiety. This theory, Dr Barton believes sufficient to account for the fluttering and strange movements of the bird; and the arguments with which this view is upheld are certainly entitled to great respect. While the anxiety and terror of the parent bird would readily attract notice, the real object of the snake, and the true cause of the mother's approach to the very jaws of destruction, would be more than likely to escape the notice of such persons as are usually called upon to observe the supposed fact.

I have seen but one occurrence that might mislead as to the subject of fascination. I have very often put animals, such as birds, pigeons, guinea-pigs, mice, and dogs, into the cage with a rattlesnake. They commonly exhibited no terror after their recovery from alarm, at being handled and dropped into a box. The smaller birds were usually some time in becoming composed, and fluttered about in the large cage until they were fatigued, when they soon became amusingly familiar with the snakes, and were seldom molested, even when caged with six or eight large *Crotali*. The mice—which were similarly situated—lived on terms of easy intimacy with the snakes, sitting on their heads, moving round on their gliding coils, undisturbed, and unconscious of danger. Larger animals were not so safe, especially if they moved abruptly and rapidly about the snakes. The birds, mice, and larger animals, often manifested an evident curiosity, which prompted them to approach the snake cautiously. Sometimes this was rewarded by a blow, as was sure to be the case when a dog indulged his inquisitiveness by smelling the snake with his muzzle. Sometimes the snake retreated, and struck only when driven to bay. Usually, the smaller animals indulged their inquisitive instinct unhurt, and were allowed to live for days in the same cage with the dreaded reptiles.*

These are the sole facts which I have seen, bearing any relation to the supposed fascinating faculty. They appear to me to lend no strength to the idea of its existence.

There is a popular belief which ascribes to the rattlesnake a most disagreeable odour, and even naturalists have been led to believe that the serpent owed to this its power to lure and stupefy animals. In this matter I agree with Barton.† I have never perceived that any peculiar odour issued from my snake-box ; and as to its ability to injure birds, the facts above stated should suffice to disprove it. As usual, however, this pound of error contains its grain of truth. When a rattlesnake is roughly handled, especially about the lower half of its length, a very heavy and decided animal odour is left upon the hands of the observer. If the snake be violently treated, causing it to throw itself into abrupt contortions, thin streams of a yellow or dark brown fluid are ejected to the distance of two or three feet. This fluid appears to come from glands alongside of the cloaca. Its odour is extremely disagreeable, and it is irritant when it enters the eye, although not otherwise injurious.—*Researches upon the Venom of the Rattlesnake, by S. Weir Mitchell, M.D.* 1861.

---

* It is proper to add, that the curiosity thus exhibited by animals, and especially by mice and dogs, was as active when the snake was not regarding the intruder as at other times.

† Barton, p. 24.

MISCELLANEOUS.

The Influence of an Acid in producing Saccharine Urine. By F. W. Pavy, M.D.—In 1854 I conducted an experiment to determine the effect of depriving the blood of its natural alkalinity. I then wished to see if I could influence the presumed destruction of sugar in the blood during its transit through the lungs. Phosphoric acid (Pharmacopœia strength), to the extent of 7½ fluid drachms, was injected into the jugular vein of a dog, and the blood of the arterial system became strongly charged with sugar. Since this experiment was performed, it has been ascertained that there is not the difference during life in the blood on the two sides of the lungs that was formerly supposed to exist; and it has become evident that it was not to arresting any change in the lungs, as I at first supposed, that the result I obtained was due. The fact of the blood being rendered saccharine, led me to infer that a saccharine state of the urine might also be occasioned. In seven instances I have tried the effect of injecting phosphoric acid into the general circulation. I find that it is an experiment which requires to be performed with the greatest nicety: the animal withstands the introduction of the acid to a certain extent without manifesting any disturbance, and it may even, at first, be injected pretty rapidly; but when a certain amount, varying in different instances according to the size of the animal, has been introduced, the further introduction requires to be made most slowly and with the utmost care, attentively watching its effects; otherwise destruction of life will be occasioned. I have found this to occur in one case after one ounce had been employed, and in another after ten drachms: in both of these cases the animals were of a smallish size. In two good-sized animals the injection of an ounce did not thus lead to immediate death, and did not produce any alteration in the state of the urine as far as regards sugar. Having carried the experiments further, however, I find that when the injection is pushed to the fullest extent that the animal will safely bear, a saccharine state of the urine is the result.—*Proceedings of the Royal Society.*

Experiments and Observations on the Structure and Function of the Stomach in the Vertebrate Class. By William Brinton, M.D., Lecturer on Physiology at St Thomas's Hospital.—This paper, itself a summary of a long series of observations, may be briefly abstracted as follows:—

The peculiar dimorphous structure possessed by the tubes of the cardiac and middle parts of the stomach in the dog, exists in the whole vertebrate class; about sixty species of which are cited by the author from his notes. Many of the variations of the stomach throughout the vertebrate class are essentially œsophageal developments, having a mechanical office. The more essential contrasts of the vertebrate stomach refer to the above dimorphous structure; which diminishing, even in man, to less than twice its thickness in passing from the cardia to the pylorus, is in most animals altogether deficient here, either with or without a great shortening of the columnar-celled tubes. The dimorphous cell-growth is always the source and exponent of the pepsinous or digestive power of the stomach on protein-compounds; which power is absent where this structure is deficient, and present (as tested by careful comparison) in the degree in which the mucous membrane contains the dimorphous cell-growth. Of those alternatives respecting the gastric juice suggested by various experiments,—namely, (1) the secretion of pepsine by the dimorphous cell-growth, and acid by the columnar; or (2) the perfecting of the secretion (itself perhaps owing these two constituents to its two kinds of cell respectively) in the open ends only of these tubes,—the latter is, on the whole, preferable. The protection of the stomach from its own secretion is effected mainly by the salivary and other secretions which enter it from the œsophagus and duodenum. The living stomach decomposes a neutral or alkaline blood, so as to set free an acid; but though transfused blood undergoes this decomposition, a saline solution not only fails to evoke it, but injures or destroys the gastric powers. There is no evidence of any exhaustion of the pepsinous constituents of the gastric mucous membrane at any period of digestion. As regards other variations of power, *age* seems to exercise but a moderate influence on the gastric mucous membrane; *species*, again, has a subordinate effect; *genus* is much more influential. For units of mucous membrane, fishes seem to have the most powerful gastric digestion. The influences of temperature, analogous in all animals, vary exceedingly as regards the absolute heats which respectively favour, accelerate, and destroy the powers of the stomach; so that the same heat which is practically necessary for the function of this organ in a warm-blooded mammal, annihilates the efficacy of the pepsine of many fishes. The action of the gastric juice is a transfer to albumen, &c., of a molecular change going on in the gastric juice—pepsine and peptone being essentially analogous to each other in properties. The formation of peptone is a hydration of albumen, as shown by various collateral circumstances of the process.

Addenda.—1. The pancreatic juice, or pancreatic infusion, which converts albumen into a substance akin to peptone, and in proportions not very unlike those which would be obtainable by using certain parts of the mucous membrane of the stomach of some animals, and which does this by a process so far *sui generis* as that it is no way shared by the salivary organs most analogous to itself in structure and function, is yet distinguishable from the gastric juice in regard to the process and the product of this change. The change is, indeed, an incident of putrefaction only, and therefore not a function of the healthy living organ. 2. The intestinal juice, or the secretion of the intestinal tubes, is neither capable of converting albumen, &c., into peptone, nor of converting starch into sugar. The offices of these tubes are therefore, probably, chiefly of absorption and of excretion.—*Proceedings of the Royal Society.*

PUBLICATIONS RECEIVED.

Quarterly Journal of the Chemical Society for October 1861.—*From the Society.*

Manual of the Sub-kingdom Cœlenterata. By Professor Joseph R. Greene.—*From the Author.*

Journal of the Asiatic Society of Bengal, No. II., for 1861.—*From the Secretaries.*

Practical Treatise on the Use of the Ophthalmoscope. By J. W. Hulke, F.R.C.S.—*From the Publisher.*

Proceedings of the Literary and Philosophical Society of Manchester, Nos. III. to VI., Session 1861–62.—*From the Society.*

Proceedings of the Academy of Natural Sciences of Philadelphia, 1861. Pp. 65 to 144.—*From the Society.*

Scripture and Science not at Variance. By Archdeacon PRATT.—*From the Publisher.*

Dublin Quarterly Journal of Science, No. IV., October 1861.—*From the Editor.*

Metallurgy. By JOHN PERCY, M.D.—*From the Publisher.*

Annales de l'Agriculture des Colonies (Algerie) et des Regions Tropicales. Par N. PAUL MADINIER. Nos. VII. and VIII., for 1861.—*From the Author.*

Astronomical Observations in the Arctic Seas. By Dr E. K. KANE.—*From the Smithsonian Institution.*

Meteorological Observations made near Washington, Arkansas. By NATHAN D. SMITH, M.D.—*From the Smithsonian Institution.*

Meteorological Observations made in Providence, R.I. By Professor ALEXIS CASWELL.—*From the Smithsonian Institution.*

Tidal Observations in the Arctic Seas. By Dr E. K. KANE.—*From the Smithsonian Institution.*

Report on the Chemical Analysis of the White Sulphur Water of the Artesian Well of Lafayette, Ind. By Dr CHARLES M. WETHERELL—*From the Author.*

General Outline of the Organisation of the Animal Kingdom, and Manual of Comparative Anatomy. By THOMAS RYMER JONES, F.R.S. Third Edition.—*From the Publisher.*

Researches upon the Venom of the Rattlesnake, with an Investigation of the Anatomy and Physiology of the Organs concerned. By S. WEIR MITCHELL, M.D., Lecturer on Physiology in the Philadelphia Medical Association.—*From the Author.*

Second Report of a Geological Reconnoissance of the Southern and Middle Counties of Arkansas, made during the years 1859 and 1860.—*From D. D. Owen, Principal Geologist.*

THE

EDINBURGH NEW

PHILOSOPHICAL JOURNAL.

On the Climate of Palestine in Modern compared to Ancient Times. By JAMES D. FORBES, D.C.L., LL.D., V.P.R.S.E., Principal of the United College of St Salvator and St Leonard, St Andrews.*

Since thermometric observations extend back for only about two hundred years, and even these are very limited, and often of questionable precision, we are compelled to rely, in any comparison between ancient and modern climates, upon authentic records of phenomena depending upon heat and cold, which are also capable of being definitely described.

Such are instances of the freezing during winter of considerable rivers and other bodies of water, the periods of harvest of different crops, and generally the limitation of the growth of certain species of plants by conditions of climate.

The first of these tests, though not unworthy of notice, is not only somewhat vague, but depends upon the recurrence of seasons of extraordinary and not ordinary severity, which we know to be amongst the most uncertain and capricious of meteorological data.

The significance of the two last tests—the date of harvest, and the growth of certain critical plants in certain localities—was ably pointed out by the eminent Danish botanist Schouw of Copenhagen. These tests form the chief arguments of his able paper on supposed changes of climate. I am only acquainted with the first portion of this paper, as published in the

---

* Read before the Royal Society of Edinburgh, 6th January 1862.

"Edinburgh Journal of Science" for 1828.* Whether the original has ever been published in full in the Danish Transactions or elsewhere, I am unable to state.

The most striking part of this interesting fragment refers to the climate of Ancient compared to that of Modern Palestine, for the discussion of which we possess data at once more extensive and applicable to a more remote epoch than can be jointly furnished by the records of any other country. Having recently had occasion to redirect my attention to Schouw's argument, and having had leisure to verify it by a reference to the researches of the last thirty years, I have thought it well to record the conclusions to which I have come, on a subject of some popular as well as scientific interest.

Passing over for the present the argument in favour of the conclusion that the climate of Palestine has not sensibly changed since the days of Moses, derived from the fact that the wheat harvest and vintage still occur at the periods of the year fixed with sufficient definiteness in the Old Testament, we will take up Schouw's striking and ingenious argument derived from the simultaneous cultivation in Judea of the vine and the date-bearing palm.

The argument is briefly as follows:—The date-palm (*Phœnix dactylifera*) was in ancient times abundant in many parts of Palestine, where its fruit ripened. This we learn from both sacred and profane authors, and also from Roman coins. On the other hand the vine (*Vitis vinifera*) was notoriously an abundant product of the same country, where it attained extraordinary perfection, and was in habitual and extensive use for the manufacture of wine. Now, the botanical inquiries of Schouw led him to conclude, that the date tree requires for perfect fertility a mean temperature of the year not under 21° Centigrade, or 69°·8 of Fahrenheit. The mean temperature therefore of those parts of Palestine where the date was historically abundant, could not anciently have fallen below 70° (in round numbers). But the vine does not endure a tropical climate. According to Von Buch, quoted by Schouw, it ceases to flourish productively in the Canary Isles,

---

* Vol. viii. p. 311.

Algiers, and Egypt, wherever the mean temperature of the year approaches 22° Centigrade, or 71·6 Fahrenheit. The co-existence of these two plants in a fruitful condition shuts us up to the conclusion, according to this author, that the mean temperature must have anciently been intermediate between 70° and 72°. In the absence of direct observations of the temperature of Jerusalem, he infers, from the ascertained modern temperature of Cairo and other places, that Jerusalem has probably 70° of mean temperature. "If, therefore," he adds, "there has been any difference at all between the mean temperature of Jerusalem in ancient and modern times, it can hardly amount to one degree (Centigrade), a difference similar to that between Copenhagen and Berlin."*

It might have been expected that Arago, when availing himself much more recently of the arguments of Schouw on this subject, would have thrown the farther light upon them which the improvement of meteorology and botanical geography, as well as the local researches of modern travellers, might have afforded. He has, however, contented himself with translating, almost literally, the memoir of the Danish botanist.†

On reconsidering carefully the evidence for the permanence of the climate of Palestine, as given by Schouw, it appeared to me that it was open to doubt on the following grounds:—(1.) That no consideration is given to the well-known facts, that Jerusalem is placed at a great elevation (2200 feet) above the level of the Mediterranean, and that Palestine is altogether a mountainous country, and therefore includes a considerable variety of climates respectively suited to different classes of plants. The importance of this consideration is such as to invalidate the otherwise ingenious reasoning of the Danish botanist. (2.) That Schouw confined his attention to mean annual temperature alone as a cause of limitation of species, whereas it is now well known that the distribution of heat at different seasons of the year forms an important element in determining the limits of many plants.

---

* Edinburgh Journal of Science, viii. 316. In confirmation of his argument Schouw adds, "The frequent cultivation of wheat in Palestine proves that its temperature cannot have been above 24° or 25° (Cent.) The growth of the balsam tree, near Jericho, proves that it has not been below 21° or 22°; and among all other determinable plants and animals of Ancient Palestine, the author could not find a single one which was contrary to the assumed mean temperature of 21°."

† Arago, "Œuvres," viii. p. 215. Compare "Annuaire, &c., pour 1834," p. 204.

To these considerations, we may add the fresh evidence on the subject arising from our being now in possession of larger data, (3.) as to the meteorological character of Syria, and of Judæa in particular ; (4.) as to the general facts and laws of the distribution of plants, and especially of the vine and palm; and, (5.) what has been somewhat unaccountably overlooked by Schouw and Arago, as to the actual occurrence of those plants in Modern Palestine.

I shall in the following pages endeavour to sum up the whole argument (which proves to be confirmatory of the opinion of Schouw as to the invariability of the climate), as it may be gathered both from older and more modern authorities.

In the interesting and laborious work of M. A. Decandolle entitled "Geographie Botanique raisonnée" (1855), we find such ample and conscientiously stated details, as to supersede a reference to any other botanical work in connection with the present inquiry. We there find it clearly laid down, that the Polar limit of the date-palm may be held to have a threefold margin—1*st*, Where the fruit comes to full maturity, as at Tunis, with a mean annual temperature of 68°·5 ; 2*dly*, Where it flowers but only ripens its fruit exceptionally, as at Algiers and Palermo, whose temperatures are nearly alike, and may be stated at 63°·7 as a mean ; and, 3*dly*, Where it is cultivated exceptionally, as a merely ornamental tree, as at Nice and Rome, the temperature of both places being about 60°.

Now the climate of Southern Palestine, whether (*a*) as inferred from the Bible and other ancient testimonies, or (*b*) from meteorological observations, as collected by Dove, or (*c*) from the descriptions of modern travellers, seems to be definitely conformable to the view that its more mountainous parts correspond to the *second* limit of the date tree, and the valleys and coasts to the *first*—a hypothesis or assumption which reconciles all facts, so far as the palm is concerned.

Shaw, in his Travels (quoted by Kitto in his "Physical Geography of the Holy Land," p. ccxxv.), mentions numerous coins belonging to the Roman occupation of Judæa, in which the palm tree is represented; in some of these it is figured with the fruit upon it (Schouw). It is more than probable that the association of this tree with Palestine, which caused the Romans to regard it as peculiarly characteristic, was derived from their first impressions of the country on the coasts of Philistia, near Jaffa, where the palm tree ripens its fruit copiously, as Professor Mitchell informs me; "and which there," as Professor Stanley remarks (*Sinai and Palestine*, p. 145), "probably first met the eye of the western world, whether Greek, Roman, or mediæval," giving rise to "the name of Phœnicia, or the Land of Palms."

I may here remark that the climate of the Syrian coast, in the latitude of Jerusalem, corresponds with that most favourable to the perfect development of the date tree. Beyrout, which is nearly 2° of latitude farther north than Jerusalem, has a temperature of 69°·4 (Dove), or nearly a degree of Fahrenheit higher than that of Tunis, and is intermediate in temperature between Tunis and the Canary Islands, both being places where the date ripens perfectly.

Jaffa and Gaza being to the south of Beyrout, must therefore be considerably warmer; and the isothermal line of 70° (at the level of the sea) must pass, according to Dove's maps, close to the *geographical* place of Jerusalem, though, in consequence of the elevation of that city (2200 feet, *Stanley*), it has a temperature far lower; in fact only of 62°·6, according to a single year's observation by an American missionary, quoted by Dove. But when allowance is made for the effect of elevation at the rate of about 300 feet for 1° Fahrenheit, this single year's result gives a temperature of almost exactly 70° for the parallel of Jerusalem. It is very probably rather higher, as Schouw had, from still more incomplete data, estimated it. From all this we conclude, that while the climate of Palestine at the level of the sea is perfectly adapted for the cultivation of the date palm, Jerusalem itself corresponds in temperature closely to Palermo, and is therefore, as already shown, only warm enough to enable it to produce flowers, but not to ripen the fruit, unless in exceptional seasons.

This inference from general meteorological facts is entirely confirmed by the testimony of modern travellers as to the conditions under which the palm, where it does occur, is found in Palestine. But it will be best to inquire, first, as to the exact localities mentioned in Scripture as characterised by the growth of the palm. This is evidently rendered necessary by the great variety of climate which Palestine presents, owing to its varied elevation. The effect is so considerable, that even if we confine ourselves to the narrow limits of Judæa Proper, it must be held to be equivalent to a range of temperature of about 13° of latitude, and that without including heights greater than that of Jerusalem itself.*

The place which, beyond all doubt, was most characterised by the presence of the date tree was Jericho, "the city of palm trees" (Deut. xxxiv. 3; 2 Chron. xxviii. 15) which, as Kitto acutely remarks, would hardly have been a distinctive name, had the palm been as frequent in Palestine as it is in Arabia and Egypt. Now Jericho, as is well known, lies not only in a valley, but, being in the valley of the Jordan, not far from the Dead Sea, it is included in that marvellous depression to which the latter belongs, and is itself probably not less than 600 feet *below* the level of the Mediterranean, or 2800 feet below Jerusalem. Its mean temperature may therefore very probably be as high as 72°, equal to that of Cairo itself. The shores of the Dead Sea are not less than 1300 feet below the Mediterranean, and must consequently have an almost tropical temperature. We are therefore not surprised to find that, next to Jericho, Engeddi, on the western coast of the Dead Sea, and one of the few fertile spots (being well watered†) in that desolate region, is mentioned in Scripture as characterised by the palm, its other name being Hazezon-Tamar, meaning, "the felling of palm trees." (See 2 Chron. xx. 2, and Ecclesiasticus xxiv. 14.) The Rabbinical writers, according to Reland and Stanley, describe the palm as a tree of the valleys (*Stanley's Palestine*, p. 145), no doubt because it grew there in perfection; although it also occurred, perhaps in single trees or small groups, near Ramah (which is intermediate in elevation between Jericho and Jerusalem), Judges iv. 5. Palm trees also grew near Jerusalem, probably on the Mount of Olives (Nehemiah viii. 15; John xii. 13); but, though used to grace processions, there is no evidence of their being numerous, still less of their bearing fruit. It is remarkable that the references to the palm tree in Scripture are almost exclusively confined to its stately and ornamental character, and rarely, if ever, as to its fruit; the vine and fig being the favourite symbols of luxuriance in this respect. Indeed it is more than doubtful whether the date-fruit is ever referred to in the Bible. The marginal reference to it in 2 Chron. xxxi. 5, as Professor Mitchell informs me, is by no means conclusive, and the derivation of the name *Bethany* may not be "the house of dates," as believed by some high authorities; and even if it be so, the word is regarded by Hebraists as signifying the fruit in a *green*, not a ripe state, when it was used by the ancients as a condiment. It cannot, therefore, be safely assumed that the date *ripened* at Bethany.

---

* According to Humboldt, 1° of latitude in temperate climates raises or lowers the temperature as much as about 270 English feet of change of level would do. (*Kosmos*, vol. i.)

† Stanley, p. 147.

I have only space to add, that the accounts of modern travellers confirm these inferences. They all agree that the palm is now rare in Palestine; that in the hill country of Judæa these trees occur only two or three together, and rarely, if ever, bring fruit to maturity (Shaw). They also agree that their disappearance in the valley of the Jordan is due not to the unfitness of the soil and climate to support them, but to the depopulation of the country, and to the rough treatment of the Arab tribes. Dean Stanley gives us the interesting information that the palm forest of Jericho was once eight miles long, "of which large remains were still visible in the seventh century and the twelfth, and some even in the seventeenth; and of which relics are still to be seen in the trunks of palms washed up on the shores of the Dead Sea, preserved by the salt with which a long submersion in these strange waters has impregnated them."* There cannot be the smallest doubt, from the meteorological inferences which I have already made, that the valley of the Jordan is at present unexceptionable, in point of climate, for bringing the fruit of the palm to maturity.

---

* *Sinai and Palestine*, p. 144. The last standing palm was seen as late as 1838. (Ibid. p. 301.)

The sum of all this part of our argument is, then, this, that the climate of Southern Palestine cannot have been sensibly *colder* in ancient times than at present; and that the evidence from the habitudes of the palm tree coincides exactly with the historical proofs of its distribution.

But it may be said that it might have been anciently hotter. This would not, however, be in accordance with what has been inferred, as to the preference given to the deepest valleys as favourable to the palm. But more direct evidence to this effect may be found from the facts of vine culture.

The vine was anciently, and even in modern times, more peculiarly the symbol of Judæa. "It was the emblem of the nation on the coins of the Maccabees, and in the colossal cluster of golden grapes which overhung the porch of the second temple; and the grapes of Judah still mark the tombstones of the Hebrew race in the oldest of their European cemeteries, at Prague. . . . The elevation of the hills and table-lands of Judah is the true climate of the vine; and at Hebron, according to Jewish tradition, was its primeval seat."* It would be waste of time to cite passages of Scripture in proof of what every reader knows—that such was the case anciently, and that no plant can be more characteristic of a climate than the wine-producing vine is of the province of Judæa in particular. In the hot valley of the Jordan, as Kitto remarks, we find no mention of it; it also appears to be less frequent and productive on the low lands adjoining the Mediterranean.

When we come to consider the bearing of these facts upon the question of thermometric climate, the solution is somewhat less precise than in the case of the date palm, which we have been discussing. It is no doubt true that the region of

---

* *Sinai and Palestine*, p. 162. It is stated, however, by Mr Henfrey (Johnston's Physical Atlas), that the native country of the vine seems to be Imeritia and Mingrelia, at the south foot of the Caucasus, and nearly 10° north of Jerusalem. Considering the elevation of Judæa, both statements may be correct.

Palestine is almost or quite the farthest south, in that particular quarter of the globe where the vine is luxuriant. We read, indeed, in the Old Testament, of the vine being used for vintaging purposes in Egypt; and numerous hieroglyphics attest that this was not an exceptional, but a common practice. No doubt, in modern times, the culture of the vine in Egypt is insignificant; yet this is partly due (as in the corresponding case of Palestine, where the artificial growth of the vine has much fallen off) to political causes, to the want of energy of the people, and to the religious objection of most of them to the use of wine. We have already shown that the valley of the Jordan has most probably a climate, at least, as warm as that of northern Egypt; and as this is unquestionably on or near the productive limit of the vine in approaching the equator, so vineyards might be expected to flourish on the mountains of Judæa, but to fail on the plains of Jericho. This, as has been shown, is the testimony which Scripture yields on the subject. It is confirmed by the reports of modern travellers; only it must be recollected that there is now no inducement for urging the production of the grape in districts abandoned to erratic and lawless tribes.

In the more purely scientific view of the question, it is to be observed that the "Equatorial limit" of the growth of plants is far less vigorously defined than the "Arctic limit." This is generally admitted; and the causes of it are sufficiently obvious. The northern limit is usually defined by two circumstances: first, the existence of frosts in winter sufficient to destroy the vitality of the plant; and, secondly, the deficiency of summer heat requisite to ripen the wood of the tree or to bring the fruit to maturity. Towards the equator, the increase of solar heat and the absence (in some countries) of sufficient moisture do not so suddenly produce their effect. And in the case of plants cultivated for human use, like vines, the influence of climate may be warded off by certain precautions as to exposure and the like.* Thus, we are told, that the vine may be brought to bear fruit in Egypt, in Southern Persia, and even in Hindostan, by planting it in pits sheltered from the rays of the sun. In most countries, too, there are spots exceptionally cool and moist, where, under proper care, cultivation may be carried on with even more than usual advantage, because the benefits of a fine climate may be obtained without its drawbacks. Of this description, most probably, was the locality of Engeddi, which is believed to have adjoined the western shores of the Dead Sea, and is still marked by a splendid spring which no doubt gave its name to the spot. In one place in Scripture* (2 Chron. xx. 2), Engeddi is characterised as productive in palm trees; and in another (Cant. i. 14), as distinguished by choice vineyards. Had the climate of Palestine in the days of Solomon been hotter than it is now, it is fair to infer that the culture of grapes in this the most southern, the lowest in point of level, therefore the *hottest* part of Judæa, would have been impossible. Besides, if we may be allowed to draw an inference from the climate of the neighbouring country of Egypt, the importance of grape culture, attested there by the Old Testament writings, and by the numerous and characteristic hieroglyphics which Kitto has transferred to his work on the "Physical Geography of Palestine," leads us to the conclusion that the climate there might be esteemed to have anciently been *more* adapted to that culture, therefore cooler, certainly not *less* adapted, that is, hotter, than it is at present.

---

* On the whole, it is difficult to add much to the facts about the southern limit of the productive vine which are relied on by Schouw—namely, that Von Buch places it in the island of Ferro (Canaries) in lat. 27° 45′, with a mean temp. of 71° Fahr. In Barbary the vine succeeds only on the coast. At Cairo,

To sum up the whole, we seem to be entitled to conclude—

1. That, judging from the known thermometric conditions of the growth and maturity of the date palm, compared with the evidences in Scripture of its distribution and culture in Ancient Palestine, the mean temperature of the site of Jerusalem, when reduced to the level of the sea, can have then differed but little from 70° Fahrenheit, which is its present value according to the best authorities. We conclude, with

---

with a mean temp. of 72°, the culture is insignificant. These facts point to the coincidence of the southern limit of the vine with the isothermal line of 72° which we have seen to pass a little to the south of Palestine.

* Hazazan Tamar signifies "felling of palm trees." Comp. Ecclesiasticus, xxiv. 14, "I was exalted as a palm tree in Engaddi."

still more certainty, that the temperature could not anciently have been *colder* than this.

2. That, comparing the conditions which limit the cultivation of the vine, we find that as it certainly was not anciently less, but *more* general and advantageous than at present, the climate of Palestine could not have been materially *hotter* than that which now belongs to its geographical position, taking also into account the modifying influence of height above the sea-level.

3. That this argument is enhanced by the evidence from hieroglyphics, and also from Scripture, that the cultivation of the grape was anciently more extensive in Egypt than it is now. That while this might be seen to point to the conclusion that these countries are *hotter* now than formerly, the difference is sufficiently accounted for by political circumstances, and the conclusion is itself negatived by the evidence to the contrary derived from the date palm.

4. Hence the climate of Palestine, being neither sensibly hotter nor colder than it anciently was, is, of course, unchanged; and the direct evidence of modern travellers on the distribution of the vine and palm in that country, leads to the same result.

TABLE I.—*Mean Temperatures referred to in preceding Paper.*

	Latitude.	Elevation. Feet.	Mean Temp.
Beyrout, . . .	33° 48′	0	69°·4
Jericho, . . .	31 50	— 600	72 ·0
Jerusalem, . . .	31 46	2,200	62 ·6
Engeddi (Dead Sea), .	31 30	— 1,300	?
Cairo, ...	30 0	40	72 ·2
Ferro, (Canary), . .	27 45	0	71

TABLE II.—*Limits of the Date Palm.*

	Mean Temp.
First limit: Palm in full fruit—TUNIS, . . .	68°·5
Second limit: Palm in flower—ALGIERS, PALERMO, .	63 ·7
Third or extreme limit of growth—NICE, ROME, .	60 ·0

Does Magnetism possess any Influence over Organic Forces?

By H. F. Baxter, Esq.*

The most inattentive observer of natural phenomena would soon be led to infer, that between the variations of the seasons and the development of organised bodies, whether plants or animals, a most intimate relation and connection existed; that between heat and light on the one hand, and vegetation on the other, the connection would be found, upon the least reflection, to be so intimate and dependent that the former might be considered, in ordinary language, as the cause of the latter. No special observation, by means of experiment, would be requisite to confirm this conclusion. It is far otherwise, however, with regard to phenomena in which no periodicity or variation during their occurrence is observed; influences may exist, and be producing powerful effects, and yet, from their constant action, be entirely overlooked,—here, it need not be remarked, we require specific observation for their elimination. Now, since the discovery of diamagnetism, and the fundamental fact that *all* substances whatever are subject to magnetic influence, the conclusion that terrestrial magnetism must exercise some most important part over natural phenomena is irresistibly forced upon our minds. To solve one of the questions which naturally arise from this conclusion was the object of the present investigation; and although the results were negative, from the inadequacy of the means employed, the principles upon which the experiments were conducted may perhaps be of some value, and worthy of publication; but a minute detail of the experiments themselves may not be necessary, and will therefore be omitted.

Becquerel,† in some experiments upon the influence of electricity over the circulation of the sap in the Chara, placed a stem of the plant in a helix traversed by a current of electricity, so that the convolutions should be either parallel or perpendicular to the motion of the sap; but no influence appeared to be exerted over the circulation of the fluid.

---

* Read before the Edinburgh Botanical Society, March 13, 1862.

† Traité de l'Electricité, t. vii. p. 250.

Dutrochet[*] submitted a plant (Chara) for ten minutes to the influence of a powerful electro-magnet (which could support about a couple of tons weight), without any effect being observed upon the motion of the fluid.

Wartmann[†] says, "that one of the principal objects of his observations has been that of the influence of electro-magnetic induction on the circulation of the sap and the direction of the organs;" but has not, so far as I am aware, published his experiments or the results.

The experiments of which the following are the results were undertaken during the years 1852, 1853, 1854, and 1855; and it was during this inquiry that the question arose as to "the influence of magnetism over chemical action," which formed the subject of two papers that have already appeared in this Journal;[‡] and in these papers will be found described the magnet and electro-magnet that were employed on the present occasion. Although the results of the experiments recorded in the present paper were, for the most part, obtained prior to that inquiry, they may nevertheless form a natural sequel to it. Their publication has been delayed from a hope that some more positive results might, on further investigation, be obtained; but the want of the necessary means, and the expense attending the prosecution of the experiments, were such that the inquiry has, for the present, been reluctantly abandoned.

As it may be considered a law in vegetable physiology that all plants have a tendency, during the germination of the seeds, to develope in two diametrically opposite directions (the root and the stem), the question arose, might not this direction be altered or counteracted by submitting the seeds whilst germinating to the influence of magnetic force? The experiments will be arranged under two heads: *First*, those in which the line of magnetic force was directed *perpendicularly* to the seed; and, *secondly*, those in which the line of force was directed *transversely* to the seed.

---

[*] Comptes Rendus, t. xxii. p. 621 (1846).

[†] Philosophical Magazine, 1851, p. 378.

[‡] Edin. New Phil. Jour., New Series, vol. v. p. 235; vol. vi. p. 25.

§ 1. *Line of Magnetic Force* perpendicular *to the Seed.*

The large magnet was placed on a table horizontally, 3½ feet from a window looking west—the marked pole uppermost.

The seeds of various plants, such as mustard, cress, rape, radish, peas and beans (broad), were made to vegetate in two boxes, one of which was placed between the poles of the magnet, the other out of the magnet's influence, but subject, in other respects, to similar conditions. In whatever way the experiment was varied, there was no effect observed that could be attributed to the result of the magnet. The influence of light over the direction of the plant was very decided, and almost led, at the commencement of the inquiry, to the supposition that the results might be due to that of the magnet; but upon removing this source of interference, by screening the plants from the light, the effect ceased.

The beans (broad) were planted with the hilum and micropyle directed in every possible way. They were also made to vegetate in water, being suspended by means of threads, without any effect upon the *direction* of the radicle or plumule being observed.

The lines of force were concentrated by means of a bar of soft iron, so as to lessen the space between the poles; the results were the same.

The beans were made to vegetate in water, supported by means of pieces of cork, so as to render them moveable, under the supposition that they might take up some definite position in the magnetic fluid, but no effect was observed. Great difficulty, however, was experienced in these experiments in consequence of capillary action. If the vessel contained more than one seed, they were frequently drawn towards each other; or, if the vessel was small, they floated towards the sides. Some of the effect might have arisen from diamagnetic action driving the mass outwards. There was another circumstance which interfered with the results; as the plant grew, the stem, becoming heavier than the root, leaned more or less to one side, until it was completely overbalanced.

As *time* forms an important element in the consideration of the results, there is one circumstance connected with these experiments which must not be overlooked—viz., the difficulty in procuring a standard of comparison. It was impossible to get two seeds to vegetate and grow exactly alike,—for the buds and roots to appear at the same time,—although the greatest care was taken to obtain them of the exact weight, size, and appearance. Any one might easily have been led to the conclusion, that vegetation was either increased or rendered more rapid under certain conditions of the experiment than in others, had it not been checked by counter experiments.

The seeds were now made to vegetate around the poles of a magnet in the following manner:—Two circular stout bars of soft iron formed the terminals of the poles, and which could be separated to different distances at pleasure. The lower one was passed through the bottom of a flower-pot containing mould, in which the seeds vegetated; no effect was observed. An absence of the roots in the beans, on the sides contiguous to the pole, was observed; but as this fact was also noticed under other circumstances, when the seed was growing near to a solid body, it could not be referred to any repulsive action on the part of the magnet.

The beans were made to vegetate in water, instead of the mould, being suspended by means of corks or thread; no effect. The vessel was placed on the pole, and the upper pole over it, without any result being obtained.

§ 2. *Line of Magnetic Force* transverse *to the Seed.*

The first experiments were undertaken with Professor Wheatstone's large electro-magnet, but the difficulty in procuring and maintaining a *constant* force rendered the results doubtful.

The large magnet was now placed vertically, the marked pole being south.

A long, deep, but narrow trough, with moveable glass sides, which fitted into grooves in a wooden frame, was now employed; the space (the width) could be adjusted to a quarter, or half an inch, or to one inch, and its length was two feet, so that a portion could be placed between the poles of the magnet, whilst the remaining portion extended beyond the influence of the poles. To concentrate the magnetic force, two soft iron bars, or rather plates of iron, were so adjusted as to form the terminals, and prevented from coming into immediate contact by pieces of wood.

The seeds were made to vegetate chiefly in mould, and in several experiments some effect appeared to be produced; the mustard or cress which was growing in the part between the poles was occasionally higher than in that portion out of the influence of the poles. This effect, however, appeared to be due to the influence of the light; for when the outer portion of the trough was screened from light by means of pieces of wood, the differences were not observed.

Beans were suspended in various directions, and made to vegetate in water, the trough having been made water-tight. No roots or mere prominences appeared on the sides in contact with those of the trough, but similar appearances were observed in those seeds that were out of the magnet's influence.

The experiments were varied by arranging the magnet with the marked pole north, then east, and then west. The results in all these instances were similar.

We should certainly not be justified, from these negative results, in coming to the conclusion, that magnetism is without any influence whatever over vegetation. I am far more disposed to conclude that the forces connected with the plant and its development are of such a nature as to resist the power of the magnet that was employed, and therefore would require more powerful means to make any effect perceptible. The reasons for forming this opinion may be gathered from my concluding observations.

Concluding Remarks.

It must be borne in mind that the present investigation comprises the question, whether Magnetism in a quiescent state (*i e.*, not in motion) has any influence over vegetation? Whether Magnetism when in motion has any influence, is another question. I will confine my observations first, to the former.

"It is a curious sight," says Faraday,* "to see a piece of wood, or of beef, or an apple, or a bottle of water, repelled by a magnet, or, taking the leaf of a tree and hanging it up between the poles, to observe it to take an equatorial position. Whether any similar effects occur in nature among the myriads of forms which, upon all parts of its surface, are surrounded by air, and are subject to the action of lines of magnetic force, is a question which can only be answered by future observation." My object has not been to develope the facts connected with the phenomena usually termed *diamagnetic*—that is to say, the influence of magnetism upon masses; but to study the influence of magnetic force upon other forces whilst in action, and to ascertain whether or no the *structure* of bodies might not be governed in their formation by it. Professor Tyndall,† in a paper entitled "On the Nature of the Force by which Bodies are Repelled from the Poles of a Magnet," relates some experiments respecting the magnetic properties of wood. Of thirty-five specimens examined, he found that they all took up a definite position in the magnetic field; the line coinciding with the direction of the fibre being equatorial (diamagnetic); only one specimen (bog oak) taking up the axial position—and this was due to the extraneous matters (iron) with which the wood was impregnated. The different woods varied in their power of set, but they evidently showed an intimate connection to exist between the structure of the wood and the line or direction of the magnetic force. Let us consider for a moment the general facts connected with vegetation. We have plants growing upon a large magnet, the earth, and therefore under the constant influence of magnetic forces. There is every reason to believe, for experiment proves it, that the actions which take place in plants, viz., nutrition, secretion, and absorption, are accompanied with the development of electrical currents; and wherever electric currents are developed, we know that magnetism exerts a directive influence over them. There is no reason to suppose that magnetism initiates or originates these currents unless motion is superadded. Instead, therefore, of considering the ascent of the stem as an instance of diamagnetic repulsion, is it not more likely and probable that the organic actions of the plant —secretion, nutrition, and absorption,—under the influence of terrestrial magnetism, are so far governed as to be obliged to take up a certain line of direction, the resulting effect terminating in the form and mode of growth which we find plants to assume? These may be looked upon as wild notions; but the real point is, are they true or false?

---

* Experimental Researches, vol. iii. *para.* 2451.

† Philosophical Magazine, 1855.

With regard to the other question, viz., What grounds have we for supposing that magnetism when in motion may have some influence over vegetation? as I am not aware of any experiments having been undertaken for the purpose of elucidating this point, let us refer to facts which bear upon it. Whenever a closed circuit of conducting matter, whether metals or otherwise, cuts or intersects magnetic lines of force in certain directions, a current of electricity is evolved in that circuit. It matters not which is in motion, the circuit or the magnet; and therefore, if a tree be in motion or a man be walking, and intersecting the magnetic curves or lines of magnetic force of the earth, and *if* there are closed circuits of conducting matter within his body or within the tree, electric currents are necessarily developed. Now we know that there are electric currents developed in the animal body as well as in plants, independent of magnetic influence.* I do not suppose, as was said just now, that magnetism *originates* these currents in plants, and therefore not in animals; but I think it highly probable, that both in plants and animals, whilst intersecting the magnetic curves of the earth by motion, that the same influence may be exerted over these currents, either by increasing them, if in the same direction, or by lowering their intensity if in a contrary direction, or if the tendency to their formation be too weak, by then aiding the actions for their formation. With respect to plants, Knight† has related some experiments, in which a tree was made to move to and fro in one direction, in a segment of a circle, and he found upon examining the tree afterwards, that it was thicker in the line of motion than in any other direction, in the proportion of 13 to 11. This result he attributes to motion; and he also alludes to exposed trees, agitated by winds and storms, as presenting a difference in their structure and growth as compared to those of an unexposed forest tree. I will ask this question, May not these results—I will not say they are—be due to the circumstance, that during the motion the magnetic curves of the earth are intersected, and consequently the various actions which take place in the plants—viz., secretion, nutrition and absorption—are influenced by the electric currents that are called forth within it?

---

* Essay on Organic Polarity. Churchill. 1860.

† Physiological Papers.

The same observations may be made in regard to animals. Theoretically speaking, motion of parts, or in other words, exercise, ought to show some results; and does not experience prove this? Look at the blacksmith's arm. Nature never intended the plant, much more the animal, to remain in one constant position; an intersection of the magnetic curves of the earth may perhaps be as necessary a condition, if not for vital action, still for the development of the different forms that are observed in substances possessing structure, as the influence of heat and light is found to be for the development and maintenance of that action.

P.S.—Since writing the above paper, I find that the subject, "The Influence of Railway Travelling upon Individuals," has been brought before the attention of the medical profession in the "Lancet." It would be premature to say how far any of the effects that have been observed may or may not be due to the intersection of the magnetic curves of the earth, until we know more of the nature of the influence that might be exerted.

Observations upon the Production of Colour by the Prism, the Passive Mental Effect or Instinct in comprehending the enlargement of the Visual Angle, and other Optical Phenomena. By J. ALEXANDER DAVIES, Esq.

The doctrine of the decomposition of white light by the prism, and indeed of coloured light, may be said to be one with which philosophers generally, perhaps universally, agree, and this apparently on the ground that the colours produced cannot be occasioned otherwise than by the decomposition of the incident visual ray, which for this purpose they suppose, or assume, to be compounded, following the example of Newton; whereas the fact is, that the production of colour in this way admits of two possible explanations—two possibilities as to its cause,—a fact which either has not occurred to them, or which they have not thought proper to acknowledge. I do not undertake to affirm that the present doctrine of the production of colour by the prism is not the probable one, and only wish to point out that the idea of its necessary exclusiveness is a philosophical error.

As has been observed, the idea or hypothesis of Goethe, that the several colours are produced by the successive weakening of the luminous undulations surrounding us, the gradual attenuation of the solar rays, is one to which more attention should be directed. The fact that colour can be produced by means in which no prismatic effect can be discerned, or perhaps conceived—as when the sun is viewed through a piece of smoke-blackened glass,—affords some presumption for supposing that the production of colour by the prism is not occasioned by decomposition, and this especially, when it is considered how difficult it is to conjecture how the prism effects the disintegration of the incident light. However, difficult as this is, it is not perhaps more difficult than to imagine how a triangular-shaped piece of glass so weakens (the attenuation varying with the several rays) the light falling upon it, so that the one objection is balanced by the other. Still, two possibilities must be admitted, if we would investigate in a logical or philosophical manner. It has not, I think, been observed by philosophical writers, that, to explain the phenomenon of the prism upon any hypothesis, it is absolutely necessary to suppose a reverberation of the incident rays, which, if not allowed, it must be admitted, absurd as the admission would be, that they are furnished with a species of sense. When a ray, or rather a small beam of light, seeing that it is not possible in any case to admit only one ray upon an object, falls upon a prism, it is, on account of the want of parallelism of the opposite side, decompounded upon passing through it, the various coloured rays suffering more or less refraction, which could not be the case unless the want of parallelism were experienced before the side were reached, inasmuch as this would be an effect without a cause; seeing which it must be concluded that the beam of light first passes to this side, being only reflected, and, after suffering the effect of it, is reverberated back,—a process which may not coincide with ordinary reflection,—and again passes through, thus suffering decomposition, or, on the other hypothesis, having its several rays variously affected. Upon either, it is very difficult to imagine how the important alterations are effected; how, upon the one, decomposition, and, upon the other, various affections or dispositions of the several rays, is the result of the incidence of the beam upon the second side of the prism, that is, relatively regarded. Unless, perhaps, by reflection against its upper side, the coloured rays could not reach the place of the entrance of the white beam,—an action which I do not suppose, thinking it probable that by a species of retrogression, which may be called reverberation, the coloured pencils are produced, which reverberation may or may not coincide with ordinary reflection, as regards the visual angle being always equal to that of the incident ray, but must at any rate be set down as having the effect of producing them. That the coloured pencils are produced merely by ordinary reflection from the second side, is a supposition almost unallowable. Before proceeding to other considerations, I must refer to one phenomenon of the prism, the immediate explanation of which is not dependent upon that of colour generally, and which, if it has been explained at all, has been set down—and this, I apprehend, erroneously—as one of the phenomena of chromatic aberration; the phenomenon is, that only the contours and internal lines and points of objects and pictures, are coloured when seen through a prism, the ground in both cases appearing of its real colour. Now, chromatic aberration is only possible at those parts of objects the several coloured images of which are not near enough together to become blended, so that, if colour is found to exist where this must be supposed, it cannot, of course, be set down to this cause. This is the case with a prism; the parts immediately beneath the eyes are homogeneous in colour, of their natural colour, if this is one, as also are all the other parts of the object or picture under this condition; but if the parts beneath the eye have lines or bands of light or shade, or any other bands, lines, or points, these, and also the marks on the other parts, will be fringed with colour, the colours on the former parts not arising from chromatic aberration, the coloured images there formed being blended, by reason of their proximity; seeing which another explanation is necessary. I take it that the uniformly coloured surface, which is not affected when seen through a prism, is so because the various rays reflected to the eye are united after being decompounded by it, and that the bands and lines in the parts immediately beneath the eye are prevented from being recomposed by reason of the disturbance of the surrounding colour.

The mental or instinctive action at work, when the rays reflected from any object are refracted in their passage to the eye, and also in the use of telescopes, microscopes, and other instruments, is a consideration which both demands and deserves a close inspection, and concerning which but little is yet, I think, understood. Whenever a stick under water is seen, it is known that its position is not what it appears to be, and the depth of its several parts may roughly be known, and both from knowledge previously acquired; but, inasmuch as the direction at which the various rays enter the eye does not lead to the object, it must be concluded that the apparent object, or the image seen, is wholly either a mental or instinctive production, a something passively occasioned, and this by virtue of the rays proceeding from the object. Now, although the depth of the object is roughly known, and depth is one disposition of distance, yet it should be inquired how this knowledge regulates the mental or instinctive limitation of the angular space made by the visual rays. That this limitation is made in every case of reflection and refraction is obvious, inasmuch as otherwise no idea could be formed either of the distance or the size of an object; and the question is, how it occurs in consequence of the visual rays, or the angle subtended by the eye, for that it does thus occur is a fact concerning the truth of which no discussion can be made. When the reflection of an object before a mirror is seen, it is at once known what is its size and distance—at any rate, if it is of a kind with which the spectator is acquainted, perhaps in every case, these points being determined by a reference to the various conditions which are known to give them; nevertheless it is not clear how they give rise to the limitation of the angular space: and so as regards the telescope, microscope, and other instruments, and all the phenomena of refraction; the visual angle is increased, yet it cannot be said how the limitation, upon which the apparent nearness depends, is regulated, except by referring it to a passive mental action or instinct, which are terms which suggest little meaning. That there is not any physical barrier to the prolongation of the angular space is clear; and, inasmuch as the impressions upon the backs of the retinas (which are only intermediate effects of the light in its passage to the nerves, and which, therefore, it does not appear are alone the things seen, or mentally experienced, by means of the visual rays, but that they never are viewed, the objects themselves, from which the rays ultimately proceed, or are reflected, being apparently what are always visible, which explains why their appearance is always according to the tactual sense, or erect) are not phenomena having this effect, not being even appreciable functions of the distances and sizes of objects, the limitation must be set down as being brought about by one of the before-mentioned causes. It may be supposed that it is physically produced by virtue of the two eyes, by means of which two sets of rays are seen in reflection and refraction, which in the former case converge apparently to a point, and in the latter really meet, or are reflected from the various points of the object; but this cannot be the case, seeing that it is produced when objects or reflections are seen only with one eye.

The light proceeding from luminous objects is in every case accompanied with something which produces the sensation of colour, a different thing, and the intensity of which is therefore a different condition, from that of the light; and as regards what is ordinarily known as colour, there is one very important question, which is, how its intensity is increased and diminished. A thin mixture of Indian ink is of a brown colour, and its lightness is increased by every accession of water; and hence it must, I think, be concluded, either that the brown colour is caused by the very thin distribution of black particles, or that the black arises from the great compactness of ones almost if not quite infinitely light,—of which suppositions I take the former to be the probable one.

The fact that black polished surfaces reflect very little light, however great the approximative perfection of the polish, enables us to draw a very curious conclusion, which is, that their colour to a great extent counteracts their reflective property, and this not mechanically, which method would be by preventing them from receiving a good polish, for this they may have, but by some disturbance at their surfaces, the nature of which has not yet been discovered: the quality of a surface of black marble, for example, by which its colour is formed, does not affect its hardness; and yet, when polished to the utmost, the amount of light reflected from it is much less than that reflected from off a white surface, of equal polish, of this material.

The apparent increase in the size of the sun and moon, when near and upon the horizon, are phenomena in explanation of which various considerations have from time to time been put forth in the Philosophical Transactions, and elsewhere, for which reason some may look upon it as hopeless further to attempt their explanation: I have thought, however, that it would be of utility to set forth an experiment which I have made, which I shall now do, and make a few observations thereupon. I am not aware that it has already been given, and submit that it shows that the dulness of these objects in the situations alluded to, is, at any rate, one cause of their then being considered to appear larger than when in or near the zenith: I say considered to appear, because the angle submitted by the eye being always sensationally the same, the differences being far too minute for sensational apprehension, the various estimations of distance, and consequently of size, are in every case either mentally or instinctively produced. If any ball, as a marble, is suspended against the light by a fine silken thread, as before a window, for example, and viewed at the distance of about thirty feet, it will actually be considered to appear to be larger than it would if seen in the hand, or above the size which the sense of touch would give, and, as may be supposed, the side next to the spectator would appear dark, which might in some cases be altogether the effect of contrast, as the light reflected from off it might not be sufficiently intense to make any sensible impressions upon the eyes ; but if it is viewed at this distance from outside the window, or when suspended to this height in the air, in both of which positions the light would directly fall upon the side next to the spectator, it will not be considered to appear appreciably smaller than it would if looked upon in the hand. It follows, I take it, that the apparent increase of the size of the ball is caused by its being supposed to be at a greater distance than is really the case, and this consequent upon its dulness, which supposition is, I apprehend, possible, the mind not being able to get rid of or throw off the conclusion which dulness, or want of luminosity in an object, always engenders, and would, of course, lead to the conclusion that it is larger than it is ; and therefore, that the inferior luminosity of the sun and moon, when in the positions mentioned, produces the same mental impression, which impression is found to exist, although, as also in the case of a ball, the necessarily previous idea of greater distance can scarcely, if at all, be caught. It may, from this experiment, be concluded, that the fact of large distances not being realizable by the mind, is not, at any rate, wholly the cause of the mental confusion which has been alluded to, and also that the ball appearing darker, and being considered larger the greater the distance from which it is seen, these objects are set down as larger in proportion to their increase of dimness, which is always the case. It cannot be denied that there is a considerable difficulty in understanding how, the distances of objects being known, whether or not they are realized, the circumstance of dimness forces the mind to consider them farther off,—nevertheless the thing cannot be set down as impossible; besides which, the supposed early persuasion, by which objects in a horizontal direction are looked upon as farther off than those at the same distance in a vertical direction,—this fact being supposed to be known to the spectator,—is also fraught with it, which fact, however, is not, of course, of any assistance to the conclusion which has been made from the present experiment, and which, in itself, is not a new one.

On the Connection between Organic Force and Crystalline Force.[*] By H. F. BAXTER, Esq.,[†]

My previous researches having led to the conclusion that the *force*, associated with organised bodies, plants and animals, is a *polar* force, the question would naturally arise, Is there any connection between organic force and crystalline force, —between organic polarity and crystalline polarity?

It might be easily shown that some of the greatest physiologists and naturalists have felt some difficulty in drawing a definite line of demarcation between crystallisation and organisation; and I believe the facts principally adduced to establish the characteristic differences are merely those connected with the mode of growth and development. Any one, however, who had not reflected much upon the subject, would be firmly convinced, and reasonably so, in his own mind, that between a plant and a crystal the differences were so great that no relationship could by any possibility be established between them. To refute this opinion, which appears to me to be fallacious, will be the object of the present undertaking.

Let us first endeavour to obtain some clear ideas regarding crystals and crystallisation, and the nature of the *forces* concerned.

Crystallisation.—Crystallisation is the symmetrical arrangement of the particles of a body when it passes from the gaseous or liquid to the solid state; the solid body thus formed is termed a *crystal*.

---

[*] Read before the Royal Society of Edinburgh, March 3d, 1862.

[†] In the present paper I have quoted freely from Professor Whewell's work "On the Philosophy of the Inductive Sciences," regarding the subject of crystallisation, and I ought in justice to that individual to have marked the passages thus quoted; but as I have endeavoured to condense some of the passages, I may unintentionally have rendered some of his expressions indistinct, and therefore make him responsible for views which he may not entertain. The same remarks may be made in regard to Professor Faraday, whom I have quoted on the subject of magne-crystallic actions.

I would call the attention of my readers to the chapter in Professor Whewell's work on "The Connection of Polarities." Professor Whewell has not alluded to the subject of organic forces or organic polarity, and I have endeavoured to show in the present paper that the time has arrived when these forces must be brought within the same category.

The force, of which solidity, cohesion, and crystallisation are the result, is that which gives to crystals their permanent existence and their physical properties. This may be called the *power of crystallisation*, or the resultant effect of the exercise of *crystalline force*.

One of the most important physical properties of crystals is their geometrical form, or arrangement of their elements in space; and in crystallography crystals are arranged into different systems, according to the degree and kind of symmetry which their primitive forms possess. The primitive forms of crystals are few, but the secondary or derived forms innumerable.

There are different kinds of symmetry,—we have three-membered, or *triangular* symmetry; four-membered, or *square* or *tetragonal* symmetry; *oblong*, or *two-and-two-membered* symmetry; *simple* symmetry, and the *cubical* or *tessular* symmetry.

Now, the parts which are termed symmetrical resemble each other not only in their form and position, but also in the mode in which they are produced and modified by natural causes; and it may be stated as an axiom, that *all the symmetrical members of a natural product are, under like circumstances, alike affected*. In the increase, development, or growth of a crystal, all the incidents of form must affect alike all the corresponding symmetrical parts.

With regard to the nature of the *force* by which the crystal is formed, it is not simply that of *attraction*. The *force* by which crystals are formed is *polar* in its character. If two atoms, A B, adhere so as to form one particle, the line A B which joins their centres must have some position in space. It may be considered as an axis (axis of symmetry), the poles of which are A B. The polarity of the particles of crystals has reference to their geometrical form. The poles in crystal are not constituted with *opposite*, but with *similar*, properties; and one of the characteristics of crystalline polarity is this, that *the opposite faces make the same definite angle with an axis*.

That crystalline polarity, and chemical polarity, are merely different modes of manifestation of one and the same force, may be inferred from the following arguments:—The two forces, crystalline and chemical, are identical; it is only definite chemical compounds, or simple bodies, that crystallise, we cannot distinguish and separate the force which constitutes the body, from that which forms the crystal. We need not, therefore, suppose that crystalline polarity *must* present the same character as electric polarity, viz., the *contrast* of properties, for we may have the force chemical existing under two distinct conditions—either in the *static* form, as in the crystal, or in the *dynamic* form, as current *force* during chemical action.

Here, then, we have the polar character of crystalline force established. In the crystal the force assumes the *static* form; but whether, during the formation of the crystal the *current* form is manifested, I am not prepared to say. The experiments of Becquerel, in which crystalline compounds were formed, the formation of the crystal may be considered as due to the electric current that was employed. Be this as it may, they only show the mutual dependence of the one upon the other, —the formation of the crystal, and the existence of the electric current.

It need be scarcely remarked, that for the growth and increase of the crystal we are compelled to assume the pre-existence of the compound, generally in the form of solution. Crystals grow by the addition of particles, and so do organised bodies. Crystals may be said to select their particles, and so do organised bodies. But it is in the development of the germ, and that of a crystal, that the greatest differences have been noticed. In crystals, the particles are added to the surface, whilst in the plant or animal the matter is taken within by "intus-susception." Again, in crystals, we have plane surfaces and angles, but in the organised body we have rounded surfaces. Having thus far discussed the subject of crystallisation and crystalline force, let us now turn our attention to that of organisation and organic force.

Organisation.—I shall assume for the present that there is one condition of "organisable" or "viable matter," which bears the same relation to organisation, as crystalline matter—the crystal—does to that of crystallisation, and shall speak of it as the "germ." Whether this "germ" consists simply of "blastema," "protoplasm," "germinal matter," or of a "nucleated cell," it will not be necessary for me to decide just now; but it will be considered as being derived from a pre-existing organism, just as a crystal was developed from pre-existing crystalline matter. This germ, then, may exist under two conditions; 1*st*, In a state of quiescence, as in a seed; or 2*d*, In a state of development, as an organism or living thing; and the force connected with it, whether we call it germ-force, cell-force, or organic-force, may also be considered under the respective circumstances as existing either in a static condition or in a dynamic condition.

Now, this germ does not grow and increase in size, like the crystal, by the mere addition of similar parts, but undergoes a *transformation*, the parts becoming differentiated. The crystal may be considered as constituted of a mass of germinal matter, which remains as such, and thus builds up the crystal; the organism, on the other hand, consists of germinal matter, undergoing, under certain conditions, a series of changes, the resultant effect of which is the growth and development of the individual organism. But this organism, like the crystal, is developed according to laws of symmetry, which may be either *simple* symmetry, *triangular* symmetry, or *pentagonal* symmetry; although this last, *pentagonal* symmetry, has been considered by Agassiz, I believe, as resolvable into *simple* or *bilateral* symmetry.

It will not be necessary to pursue further the changes that occur during the development of the organism, these I shall allude to in my concluding remarks, but let us now endeavour to get some clear idea regarding the nature of the forces concerned in these actions. I must refer to my previous papers* for the evidence upon which I have come to the conclusion that the actions which take place in the living body during growth and development are *polar* actions, for they are accompanied with the same manifestations of current electricity as ordinary chemical actions, and therefore the force associated with the organism—organic force—is a polar force.

---

* Essay on Organic Plants. Published by Churchill. London, 1860.

Here, then, we have a most intimate relation or connection established between organic force, chemical force, and crystalline force; so far as they are *polar* they are identical.

Since the different forms of polar force are so intimately related and connected with each other, it becomes important to ascertain in what manner the crystalline and organic form of force are related to other forms of polar force, and especially to the magnetic.

§ 1. *On the Influence of Magnetic force upon Crystalline Bodies.*

If we take a crystal of bismuth, and suspend it between the poles of a magnet, we shall find that, under certain conditions, the crystal will take up a definite position, and return to it when moved. If we suppose an imaginary line to pass through the crystal, this line in bismuth being from one obtuse solid angle to the other, and perpendicular to the brightest cleavage plane, it will place itself parallel to the magnetic lines of force, or in the *axial* direction; but if this crystal be moved, so that this imaginary line, which is called the magne-crystallic axis of the crystal, be placed in a vertical position, the *setting* power of the crystal is gone, and the mere dia-magnetic effect remains. The law of action may be thus stated:—*The line or axis of magne-crystallic force* (being the resultant of the action of all the molecules) *tends to place itself parallel, or as a tangent, to the magnetic curve or line of magnetic force passing through the place where the crystal is situated.* The crystal does not possess the same properties as a magnet, viz., north and south points; for if the crystal be turned round into the diametrically opposite position, the same effect will ensue—there is neither attraction nor repulsion. The opposite ends of the crystal do not present opposite properties as a magnet; either end of the mass, or of its molecules, is to all intents and purposes, both in magne-crystallic phenomena, and in the ordinary results of crystallisation, like the other end; and in many cases, therefore, the words *axial* and *axiality* would seem more expressive than the words *polar* and *polarity*.

We must not consider this imaginary *line of force, or magne-crystallic axis* of a crystal, when in the magnetic field, as a real definite elementary line existing in the crystal as such; for it may be, and no doubt is, the resultant effect of the compound dispositions of the forces in the crystals; and the final *set* of the crystal in the magnetic field is due to the combined reaction of the magnetic and crystalline forces upon each other.

I shall not enter further into the deportment of the different crystals when placed in the magnetic field, and the theoretical views that may be entertained to account for the phenomena, as these may be found in the published papers of Faraday, Plücker, Tyndall, and others. My chief object is to show that there is a definite relation or connection between magnetic force and crystalline force, as manifested in the deportment of a crystal when placed in the magnetic field, the position of the crystal depending upon its structure.

§ 2. *On the Influence of Magnetic Force upon Organised Bodies.*

Professor Tyndall[*] has shown that organised structures, such as wood, when placed in the magnetic field, take up a certain and definite position, the line, coinciding with the direction of the fibre, setting in the equatorial position.

These facts (the deportment of the crystal and that of wood, when subjected to magnetic force, evidently depending upon the structure of the substance), may be adduced as further arguments in favour of the identity of the force both in crystals and in organised substances. It would, however, be extremely premature to establish this as a law, from the little experimental evidence that can be at present adduced in regard to the influence of magnetism upon organised bodies; but as far as it goes, combined with other arguments which have been adduced, it tends to establish their identity.

The relation between magnetic force and organic force is further shown in the development of current force during organic action. Upon the connection between current force and magnetic force, I need not dwell.

---

[*] Philosophical Magazine. September, 1855.

Concluding Remarks.

The conclusion to be deduced from the foregoing arguments is the following:—That the force connected with crystals and organised bodies is identical, viz.—a *polar* force; and it remains now to point out the real distinctions that can be established between the formation of the crystal on the one hand, and the development of an organism on the other. This distinction is manifested in the mode of growth. In the crystal there is the simple addition of similar parts, the only condition being a supply of material, usually in the form of solution, for its growth and increase; whilst in the organised body, on the other hand, the growth is accompanied, not by a mere addition of similar parts, but the substance (the food) must be formed, and undergo transformation, before it can be added to the structure of the organism; and not only that, but for the perfect development of the individual there must be a series of changes,—the food must become sap or blood; and it is from this sap or blood that the perfect tissues are formed. Crystallisation may be said to consist in the deposition of homologous parts, according to the laws of symmetry, whilst in organisation, the parts, previous to their deposition, must undergo a series of transformations; so that life may be said to consist of a series of constant changes of organic matter, which result in the development of an individual organism.

Now, the real point for consideration is this, are we justified, from the mode of growth alone, in drawing a real and essential difference between organisation and crystallisation? To answer this question satisfactorily, we must consider the object we have in view.

In the classification of things as individuals, for the purpose of Natural History, our divisions are generally conventional, things are usually divided according to external differences and resemblances—*forces* are not alluded to, or are overlooked, and therefore we are apt to conclude, that a greater distinction exists in the nature of things themselves from the manner we view them, than exists in reality. In Physics and Chemistry, forces are considered in an abstract manner, whereas, in Natural History, the objects themselves are studied; all that which cannot be perceived by the senses belongs not to its domain, the properties of bodies are considered abstractedly, but only as characters. It may, however, be stated, that if the same plan were pursued in regard to Natural History as in Physics and Chemistry, the mind would deal in abstractions so wide and general that no positive knowledge would by this means be obtained. To the justness of this observation no one can refuse assent. My object has been to show that between crystalline force and organic force no essential distinction can be drawn; but the mode in which these forces are manifested may at the same time present such differences as to lead, for the purpose of classification, to a distinction as individuals.

Hitherto I have confined my observations to the growth and development of organised bodies, and have assumed, as with a crystal, the pre-existence of organic matter; the question, however, arises, What is the primary form and constitution of organic matter; or, in other words, can organic matter be formed from inorganic matter? The primary form of organic matter has usually been considered as a nucleated cell; but I believe at the present day that this is not essential; the microscope alone cannot teach us what are the essential constituents of "viable matter"—this the chemist must do. When the chemist can tell us the constitution of organic matter in its first stage, at its first formation, then we may have some hope of being in a condition to answer the question satisfactorily. What the chemist has analysed are compounds formed during the process of organisation during the changes that take place in the growth and development of an organism. This will not answer our purpose; and until we can get some clear notion concerning the real constitution of the primary form of viable matter, we are stopped at the very commencement of the inquiry.

Professor Graham[*] has found it necessary to divide substances into *crystalloids* and *colloids*, and considers "the colloidal to be a dynamical state of matter; the crystalloidal being the statical condition. The *colloid* possesses *energia*. It may be looked upon as the probable primary source of the force appearing in the phenomena of vitality. To the gradual manner in which colloidal changes take place (for they always demand time as an element), may the chronic nature and periodicity of vital phenomena be ultimately referred." Let us take a portion of colloidal matter, and assume, for argument's sake (although no opponent might grant it) that, under certain conditions, this might become a portion of viable matter, and form a cell. Here we get the first starting-point of an organism. But what are our difficulties? Let us compare it with the development of a crystal. For the mere growth of a crystal we should only require a solution containing similar substances, but for the cell to grow and become a living organism, we should require the influence of another cell, either a germ-cell or a sperm-cell, and also to know the kind of food it would require for its development. To become a plant it would require a certain kind; to become an animal another kind; so that, for the perfect development of this cell into any particular kind of organism, it would require to be placed under different circumstances during its earliest stages, so as to produce the different forms and varieties that are observed in the organic world. A knowledge of the "conditions of existence" is therefore the great desideratum.

---

[*] On Liquid Diffusion applied to Analysis. *Medical Times and Gazette* Aug. 3, 1861.

I do not feel the difficulty that is generally entertained regarding the supposition of the *origin* of organic matter from inorganic matter; it is usually, perhaps, from pre-existing organic matter, but I believe it may arise without assuming this mode of origin. The conditions for its development is the great difficulty. The germ, whether from pre-existing organic matter, or from other sources, if exposed during its earliest stages to certain conditions, may become developed into what we may term a different organism to that of its parent. It would be in the earliest stages, perhaps, that the differences would be more readily taken up. We know that a cell with or without a nucleus may be predicated as the starting-point of the whole range of the organic kingdom. And as we have no reasons for supposing that different forces are called into action, excepting in the higher grades of development, but what exist in the inorganic kingdom, that there is no real and essential difference between the force connected with organised bodies and that connected with crystals, these facts would go far to prove the non-necessity of a fresh act of creation for each individual organism, as we should be compelled to assume the same necessity for each individual crystal.

On the Condition of the Salmon Fisheries of England and Wales in 1861; *with a Notice of some of the Modes of Fishing, especially those practised in the Severn and Wye; and Remarks on the Natural History of the Salmon.* By Sir WM. JARDINE, Bart., F.R.SS. L. & E., &c.

Introductory Remarks.

In the twenty-fourth year of the reign of Her Most Gracious Majesty Queen Victoria, a Royal Commission was appointed "To inquire into the salmon fisheries of England and Wales, with the view of increasing the supply of a valuable article of food for the benefit of the public."

The commissioners appointed were Sir W. Jardine, Bart.; Joshua Fennell, Esq., one of the Inspecting Commissioners of the Fisheries in Ireland, and George Kettilby Rickards, Esq., Counsel to the Speaker of the House of Commons; and they were efficiently assisted throughout by Frederick Eden, Esq., as their secretary.

These gentlemen met by arrangement at Gloucester on the 10th September 1861, and afterwards visited and inspected personally all the principal rivers and salmon fisheries in England and Wales, and took evidence thereon. They asked and received answers to 18,000 questions, printed in a Blue Book of 545 pages, and laid their report, for presentation to her Majesty, before the Home Secretary in the February following. This might have sufficed; but as blue books are fitted neither for railway reading nor for perusal from the pillow, and 18,000 questions would trench severely on time and the memory, and as the phraseology and limits of a report made under these circumstances must be somewhat strict and concise, it has been thought that the information obtained, if given in another form, combining some notes upon the different modes of fishing employed, and on the natural history of the several species brought under observation, might not be unacceptable. An attempt to do so has now been made.

No subject has been more legislated upon than that of the regulation of the salmon fisheries of Great Britain and Ireland; and while this indicates the importance attached to them, it has been at the same time mainly caused by the want of a correct knowledge of the facts relating to them, by ignorance of the habits and natural economy of the species, and by parties looking at one or two insulated points only, instead of viewing the subject and the various interests connected with it as a whole.

In the early state of all countries the wild animals, birds and fishes, were killed for food, or to assist in clothing, indiscriminately at all times, and without regard to the seasons of breeding. The thinning out of these, sometimes their entire extirpation, invariably followed the increase of population in the older countries as well as in the new; and thus it was that their great economic value was early appreciated, and laws and regulations were framed for their protection during the breeding seasons, and to check what had become an abuse of the gifts of nature.

As wealth increased, other agencies came into operation. The immense extension of our manufactures and mining operations, and the various scientific appliances to these and to agriculture, all had their influence on the number of wild animals, while the machinery employed in mills and inland navigation especially interfered with that of those inhabiting the waters. As wealth advanced, so in proportion did luxury; game and fish must be had; as the facility for transport increased, the demand enlarged with it, and new contrivances for capture, "improved machinery," followed, to keep up with the extended calls. But a farm will only produce to a certain amount,—even with the greatest care and culture that has its limit; and if we look at the poultry and fish shops of London and the great manufacturing towns of Great Britain, and calculate the enormous supply of game and fish there daily exhibited through the season, our fears that by-and-by we shall not be able to produce the supply required are not groundless. Add to this the demand at seasons not legally open, for export and otherwise, and the case becomes far stronger; and when foreign countries throw open their markets for game and fish at seasons when they are unfit for the market, and not legally saleable here, the temptation to transgress becomes stronger still, and we can scarcely hope by any means to keep up the supply. The salmon fisheries of England and Wales have suffered from all these causes, even though in most instances they are public property, and might have expected public protection. But they have been at all hands most shamefully neglected; the greater stakes have been sunk needlessly and without reason into the lesser, for commerce and salmon are quite compatible. Demand sharpened invention; more deadly engines swept the coasts and estuaries; retaliation harried the upper waters—as "few salmon were permitted to ascend, few should be permitted to return;" and the fisheries have reached that worn-out and wasted condition stated in the Commissioners' Report. So it was that the cry of *over-fishing* got up: "salmon in England and Wales were getting extirpated;" and the record of large rentals from Scotland, and improvements in Ireland, induced the belief that something was wrong, and that a remedy was wanted. There is, however, no difficulty in the case. The salmon fisheries of England and Wales were just numerous farms, as badly managed as some land districts were thirty years since; it was all abstraction from the soil, without regard to return or rotation—it has been all abstraction from the fisheries, without regard to breeding or season. They are wrought-out farms, and require new tenants with enlightened views and such command of capital as will enable them to wait until the losses are repaired. The capabilities of the subject are excellent. Throughout all the abuse and waste, it has been able as yet not only to meet in a great measure the demand at home, but also to send out a large recognised export, while, at the same time, a clandestine export, at seasons most ruinous to the fisheries, has been carried on. The declared value of the export of salmon to France in 1860 was L.10,000.

The clandestine export there is no means of ascertaining correctly, but it is widely spread and general, and from three to five tons are authentically known to have left Billingsgate Market in a single day.

A natural question arises, Why should England or Wales have been so long blind to their own bounties, while elsewhere large supplies of salmon were yielded to the great markets, and large incomes drawn? We do not presume that the English and Welsh families despise a good rental, and many of them are the best general sportsmen in the world; yet they undertake long journeys for the sake of good salmon fishing; they visit Scotland and Ireland, Norway, and even North America in search of sport, unconscious of what may be found in their own Wye, and Torridge, and Taw—or of what exists, perhaps, within a morning's easy ride, or even on their own properties! Various circumstances may have tended to cause this. The tidal fisheries in England and Wales are open to the public under common law right. The exceptions to this are not numerous, and rest upon ancient grants to the Church, or on some of later date to private parties; but the proprietor of the lands on each side of an estuary or tidal stream has not otherwise an exclusive right to the salmon fishery. He could and did fish under his common law right; but after fixed engines were introduced, and chiefly with the view of maintaining his title, he claimed a rent generally insignificant, for permission to drive stakes or fixtures into the ground; and he thus could not have a monopoly of or exercise a private property in the fishery, as was the case on some parts of the shores of Scotland. These *public* fisheries were abused, manufactories arose on the rivers, obstructions were erected, close times were scarcely known, or if so, were neglected; and a spirit of retaliation gained on the fishing population, sometimes reaching to the extent of mutual little forays, subversive in turn of fixed nets and obnoxious mill-weirs. These annoyances now and then, as in Rebecca's district, took even a more aggravated form, and seriously endangered property; and landed proprietors, anxious to see the law not altogether set at naught, with the sanction of the Government, got act after act passed, directed chiefly at some glaring abuse which at the time had called forth their energies, but mostly inefficient and unworkable as general measures. On the other hand, speculations thought to be more profitable than salmon-fishing gained the attention of other proprietors; and they, under the shelter of their private rights, overlooked those of the public, and set up erections fatal alike to the continuance of salmon, or to the share their neighbours higher up the river should receive. Altogether the case seemed hopeless. The public in the estuary, the millowners, miners, and population above it, seemed to take the matter into their own hands; every feeling of parties was antagonistic; there was no co-operation; and the proprietors who really did take an interest in the fisheries were disgusted, gave up interfering with the abuses, and preferred seeking their sport at a distance to losing their money and tempers at home.

Now, these fisheries being in the position above stated, another question suggests itself, What was the need of appointing the recent Government commission of inquiry, when so little had arisen out of the many previous inquiries, and the blue books consequent upon them? About the beginning of the century, field and river sports were in a great measure confined to the landed proprietors. The sale of game was not legal; permission for a day's shooting or fishing was a matter of great favour, and could sometimes only be obtained by considerable interest. The renting of a shooting or fishing was nearly unknown, and game or salmon were presents of the highest class; while from the want of rapid carriage, salmon could with difficulty be transported far in any quantity, during its best season, in a state fit for the table or market. Steamers commenced the change, Railroads completed it. Fisheries and good angling, hitherto scarcely known except in their own vicinity, were brought to light. Previously there had been abundance for the local supply, and at a low price. But the supply now vanished, except on the payment of a very high retaining fee; and the recollection of the former abundance and present scarcity of good fish enhanced the relish, and inquiry among the inhabitants as to the cause of the change has become general. The class of sportsmen has also changed. Commerce turned out princely fortunes; pursuits not before thought of, at first attracting but a few, soon spread among men of all trades and professions, and shooting and fishing became the coveted recreations. Many ludicrous occurrences took place at first, and the class was laughed at. How could it be otherwise? A gentleman restricted during his previous life to a narrow sphere, through fancy plates and descriptions, was led to adopt certain ideas in reference to sporting and the costume requisite for it. His outfit for the field or flood was furnished by the most refined city professor, and contained everything except the useful. His ideas of what he was to do came from the same sources, and his discomfitures were numerous. Reality and practice soon overcame these, and our commercial chiefs became good sportsmen. They took and liked their recreation; and how could they better spend part of their honourably and honestly earned gains than in recruiting their own health and that of their families? What better recreation than that afforded in the pure air of distant sporting lands? Moors and rivers are now everywhere let; and railroads carry the sportsman and his tackle, his servants, commissariat, champagne and ice, from the crowded city whithersoever he will. The anglers return again to business; their doings serve for the winter's after-dinner converse; they are listened to by aspiring beginners; fish of all sizes are dreamt of; and troops of sporting spirits are begotten, precocious as parrs, ready to start next spring on their first excursion.

At this time attention in England was frequently directed to the value of the Scotch fisheries. Several committees of inquiry had been carried through, and attempts were made to increase the produce of the fisheries by artificial breeding. The discussions on the natural history of the young salmon or parr, the breeding ponds of Drumlanrig and Stormontfield, all tended to keep the subject before the public in its most attractive form. The salmon fisheries in Ireland began to show decided improvement under a Government supervision; while the *Field*, the country gentleman's newspaper, kept the fisheries constantly in its columns, and enlisted anglers of all classes in the cause. In short, angling became fashionable, the public at large got the catchword, and those really interested took the opportunity *to call for an inquiry.* It was full time for this. The check has been given before it is too late; for had a wholesale destruction such as we had clear evidence of, or witnessed, continued at all seasons of the year, the utter extirpation of salmon must by-and-by have taken place. But this very abuse and destruction makes the case more hopeful; for with proper and suitable regulations it will not be difficult to restore the rivers which have maintained a produce under such disadvantages.

Severn.

The Severn has been celebrated for the early condition and fine quality of its salmon, and notwithstanding the rude fixed engines by which its estuary has been long very extensively fished, it once possessed every requisite for a first-class salmon river.

If we regard the Bristol Channel, between Bull's Point near Ilfracombe, and Portymon's Point on the opposite coast of South Wales, as a salmon fishery, there is no tidal opening or firth to be compared with it (except that of the Solway) within a line drawn between Kirkcudbright on the Scotch side and Whitehaven or St Bees' Head on the English shore. The Solway is considerably less both in its water drainage and in the length of the river-courses flowing into it, but both firths possess several points in common. Several large and important rivers discharge themselves through their estuaries into them; intermediate among these are rivers of lesser size, which salmon and sea trout also ascend regularly, while many still smaller streams flow from every valley and glen, up which, at a later period of the year, the migratory fish also run, but do not continue longer than to deposit their spawn. These latter water-courses, though far from unimportant, can only be looked upon as *breeding-grounds*, not as *fishing-grounds* where a supply of salmon throughout the season could be regularly obtained, or where angling throughout the year could be pursued with any certainty of sport. The great mass of salmon and trout that are bred in these various streams enter the firth or channel in common; and although many of them seek and may find the rivers of their birth, those which are bred in the smaller streams mingle with the others, and swell the spring and summer produce of the larger rivers. It is quite clear, then, that any channels or firths having the natural characters we have now mentioned, must be legislated for as a whole, and that any Act of Parliament framed for such waters must be founded upon uniform enactments, arrangements, and regulations.

The Bristol Channel, between the Taff on the Welsh side and the Axe on the Somersetshire coast, receives a large mixture of fresh water on the north side,—a drainage or water-shed from no less than 8580* square miles is discharged into it from the Severn, Wye, Usk, Avon, and other smaller streams,—and this influence is without doubt felt by the fish which hover about its mouth. It is in the tidal estuary of the Severn below Gloucester that the principal salmon fishery is now conducted by fixed engines. One of the best localities to examine these is at Gatcomb, on the southern side. This is easily accessible by rail from Gloucester, and the station is situated close to the water's edge, with putcher stages within a few hundred yards distance. All the modes of fishing now employed can be examined here; and there is much, besides, to interest both the geologist and botanist.

Lade Nets.—Lade nets are bag nets on a frame attached to a long handle. They are pushed before the fisherman, and are employed chiefly for taking shrimps; but they are also particularly constructed and used for catching up the salmon frequently left in the pools and "lades," which remain at the receding of the tide and at low water.

Stop Nets are fished from a boat. These are more extensively used in the Wye and Usk, &c., and will be noticed when we mention these rivers.

Putts and *Putchers*, or *Trumpets*, as the latter are termed from their shape, are the special engines used in the estuary of the Severn for taking salmon; and they form there by far the most extensive salmon fishery, by means of fixed engines, in any part of the English or Welsh waters. These machines have been employed as far back as can be remembered, and are first taken notice of in the Act of Elizabeth (I. chap. 17, 1558), as butts, among other engines for which regulations were made,—"*Net, Weele, Butt.*" They are, in fact, engines of the most primitive construction, rude almost in the extreme; and we can scarcely suppose the fishery of a river so valuable as that of the Severn to have been conducted so long without change or improvement.

---

* Peterman's Hydrographical Map of the British Isles.

Putchers or trumpets are long, conical, wicker-work baskets, with a mouth of two feet wide, gradually narrowing and ending in an opening so small as to prevent a fish of moderate size passing through. This, indeed, is frequently abused, and some are made so small as to take fish of two pounds weight. The stake or framework for these engines is about thirteen or fourteen feet high, and is fixed into the shore in two parallel rows of various length, from high-water mark seaward. These are bound together by cross-bars, on which rest the *putchers*, placed one above another in rows, with the wide mouth up or down stream, as they are intended to catch fish upon the ebb or flow of the tide. The greatest number are set with the mouth up the river or to the stream; the salmon falling down with the current enter the large mouth, and are literally jammed in the narrow end, which admits the head only, and holds the fish secure. The fish are thus often much injured, and rendered unseemly for the market by the scales being rubbed off in the struggles to escape, and no unclean, unseasonable, or old fish that enters can again escape or be let out alive.* The tide in the Severn rises to a great perpendicular height, often exceeding twenty feet above the top of the putcher stages;† and it is considered that comparatively few salmon are taken during the flow, the fish swimming near the surface and above the mouths of the putchers as soon as the tide rises a few feet above them. Most fish are taken in the ebb, or in the putchers with their mouths set up the river, proving without doubt that a large number of fish ascend so far, and return again, without ever entering the fresh-water part of the river; but whether it is that salmon in a certain condition hover about the estuary from day to day or from week to week until they find it agreeable to ascend, or merely that those return the hindmost of the shoal which only reach a certain way before the ebb commences, and do not feel the influence of the fresh water sufficiently to carry them on, is not yet distinctly made out.

---

* Minutes of Evidence, 1861. Mr. Thos. Sargent, 1482, 1492.

† At Oldburgh the rise above low water is thirty-three feet.—Min. of Evid. 1861. Mr Joseph Robinson, No. 713.

The *putts*, or putt-nets, as they are sometimes called, are placed on the same kind of stages. They are also formed of wicker or basket work, but are more complicated, and the wicker-work is closer, and executed with more care. The whole machine is about twelve feet long, and consists of three parts, which can be attached to each other as occasion requires: the kipe, butt, fore-wheel or biddle. .The diameter of the chief part, or kipe, is about five feet at the mouth, and fourteen inches at the lower or narrow end. The butt is fourteen inches wide at the neck and six at the lower end. These take large fish by having cross-bars placed in the narrow end ; and to this can be affixed at will the third part, the *fore-wheel* or *biddle*, constructed somewhat like a mouse-trap inside, and used for taking everything small—shrimps, small soles, young cod, flounders, eels, lamperns, &c., &c. In one taken off a few days before, we found shrimps, a small eel, and a rock pipit,—in fact, nothing that enters the large, open, five-feet-wide mouth escapes when this fore-wheel is kept attached. The putt-net is extremely destructive to all young fish, and in spring, when the salmon fry descend, they are taken in hundreds.* The fishermen, however, say that they now remove the fore-wheel during the fry season, and it is the river conservator's duty to see that this is attended to.

In 1825, and previously, it would appear from the evidence taken before the committee on the salmon fisheries of the United Kingdom, that these putts and putchers were erected and allowed to remain in fishing order during the whole year, and that the removal would have been too expensive ; and thus far improvement has been made, that they are now removed during fence months. By a report on the Severn and Teign salmon fisheries, July 1843, we are informed that these engines have been much increased in number. At present in the estuary of the Severn there are from 80 to 100 putt and putcher-stages employed; many of them have "stanks" and brush or wicker-work "hedges," so as to guide or drive the salmon on to the front or fishing face of the stage. These stages employ from 50 to 500 putchers on each, and some fishermen possess above 1000. Altogether, from their number and contiguity along the shores, they are a formidable obstruction in the run of the salmon. They are specially objectionable to the proprietor or fishermen, as being precarious and uncertain in their mode of operation, two salmon out of two hundred putchers being considered a fair average take in the tide; as injuring the fish for the market by their mode of catching;—and to the public fisheries by the impossibility of releasing old or unseasonable fish, which, when they have once entered the open mouth, cannot be taken out unhurt. They are very destructive to young fish of all kinds when the fore-wheel is attached, and it would be impracticable to put them out of fishing order so as to observe a weekly fence or close time.

---

* "Is that fixed machinery very destructive to the fry? Uncommonly; that has been a great source of destruction. They take millions in a night."—Mr Evan Provert, Rep. Sal. Fish. Un. King. 1825, p. 6.

It may be asked, If these engines were removed, how would salmon be procured for the public supply? At present various parts of the estuary are fished with draught nets; and although some of the localities where a putcher stage is erected may not be suitable for landing a draught net, they might be employed in many other places, and the use of nets with a larger mesh would remove the objection of the strength of the current, so much urged against their practicability. What are called "fleet nets" might also be worked, and in addition we should have the tidal waters above to assist the supply. But this would be unjust, say the putchers; you force us to pass a number of fish which we have a right to, or to which a right has been taken. The injustice is all on the other side, for the monopoly of the lower waters has gradually crept on. The recent erection of weirs and the increase of the fixed engines have made it nearly complete, and at the same time the fishery of the whole river has been most seriously injured.

The tidal waters of the Severn above Gloucester are either held by special grants, and are fished or let by the proprietors; or (as in most cases) they are free to the public, and a small annual rent is paid, sometimes in fish, to the owners of the adjoining lands for the convenience of landing the nets, or for a "fish house" and other accommodation.* Certain men or families who have sufficient capital join and fish, three men being required to each net, and they arrange among themselves taking the draughts at the different fishing stations alternately.† Above Worcester there are very few nets, at Worcester six or seven, and between Worcester and Gloucester about twenty. Several nets are in use, which employ about sixty men. These salmon nets, fairly fished, are not injurious; but other nets are in use, and nets of almost every description, form, and size of mesh, may be seen drying on the island below the bridge at Tewksbury; and when a small mesh is used in spring, taking the salmon fry cannot be avoided.

The greatest injury to the Severn in the tidal part of its course is caused by the large navigation weirs erected very lately under Act of Parliament, and sanctioned by the Admiralty. By the evidence of Mr Griffiths, who resided at Gloucester, and should have been well acquainted with the river, there were no weirs or obstructions in 1825.‡ Mr Griffiths, when asked if there were no weirs on the Severn, replies, "I am not aware of any upon the Severn; so far as my knowledge extends, there is no weir whatever." And although by the Severn Navigation Act salmon were recognised, for it was declared that there shall be openings "sufficient to pass the fish," this vague provision was not acted upon, and the proprietors of the land adjoining and the public looked on during the erection of the weirs, and either dared not or did not think it their business to interfere with the operations in progress. Only a few years since, a new cut or channel for the Severn was made below Tewksbury, upon which a very formidable weir was erected. It is a complete barrier to this great river; and what fish do get up force their way, and struggle through the locks.

---

* Min. of Evid., 1861. Mr Charles Reed, No. 413.

† Ibid., Nos. 418, 423.

‡ Rep. Sal. Fish. U. K., 1825, p. 9.

There can be no doubt that the salmon fishery of the Severn has decreased, though sixty or seventy years since there were fewer fishermen engaged, and the take by individuals was much larger than it now appears, scattered over numbers. We learned from some old books kept by the ancestors of Mr William Viner Ellis, that in 1792 (which was a remarkable year), in one week, from 29th January to 5th February, in four fisheries, 292 new fish were taken weighing 4583 lbs., or an average of 15½ lbs. each; many would be of greater weight, but the size of these fish tells more for the Severn at that period than even the quantity. In the lower waters and estuary of the Severn, which we have been considering, salmon are the principal element of value in the fishery. The local name "sea trout" is used; but the river being closed, we did not identify it as *S. truta* or *eriox.* It is a scarce fish, and runs rather late. Common or brown trout at present forms no element in the rental of the lower Severn, although it is scarcely fair to overlook the subscription drawn by the Association, which is chiefly paid for the right of angling trout. These are taken of good size and quality, many of 1½ lb. and 2 lbs. weight; and at Beverley Weir, which seems a favourite locality, trout 4 lbs., 8 lbs., and as high as 10½ lbs., have lately been taken. The shad is a more important element, the fishery for which takes place about the end of March and in April. The value amounts to a third of the whole, and sometimes even the fishermen depend on the shad and twaite for their rent.* Seventy or eighty dozen per net are sometimes caught in a night,—more than a ton weight; cart-loads are brought into the city of Gloucester in a morning, and people called Scudders wait for them on the banks, and sell them in the neighbouring county and towns. Flounders, eels, lampreys, and lamperns also assist. The lamprey is not so much sought after as it used to be. "The lamprey eaters seem all dead," says Mr Viner Ellis. Shad spawn on different fords below Worcester.

In the upper waters of the Severn the effects of the weirs have also been severely felt, for all the fish mentioned being migratory, or seeking the fresh waters for the purpose of spawning, formerly ascended as far as Shrewsbury. Salmon are still enabled to struggle through, running the gauntlet over weirs, through sluices, locks, and slaughters, and some reach Lord Powis's weir, or Pool Quay, near Welshpool, one hundred miles above the tideway; but the large navigation weirs have effectually shut out shad, flounders, and the smaller migratory fish from all the higher parts.*

---

* Min. of Evid., 1861. Mr Charles Reed, No. 508. Mr Sam. Long, No. 828.

Lord Powis's weir is at Pool Quay, nearly one hundred miles above the tide, and flounders, shad, &c., as already stated, have been known as high as this barrier. This weir supplies water for gypsum and grain mills, is placed quite across the river, and is inaccessible except in extreme floods. We saw this at half-flood, with a very large body of water flowing over. Various salmon attempted it while we stood by, but not one could either leap it or stem the long run of the slope; and even if they could have done so, and reached the top, a projecting tree or log of wood, along the whole ridge, would almost certainly turn them back. Lord Powis has a fish trap at one side, and we were assured by a person who afterwards joined us, that this was never fished except for his Lordship's private use. When we came up to the weir, the trap had the water running through it, and could have been put in fishing order in five minutes. It was now close time. We do not say any one made use of it, but Lord Powis had placed there a strong temptation, when there was a good many salmon below the weir, and all the fishing gear in their places. The opening or shutting of a sluice made the whole difference. The night before we saw this weir, the river had been extremely high, running almost smooth over the top. We do not think salmon run freely in these extreme floods; and if they did, this flood was an exception seldom occurring. Lord Powis's weir cannot be overcome; and his trap, when not *fishing*, and in close time, is *shut*, and thereby closes the only narrow access to all the river above. It is computed that forty miles of good spawning ground are barred out by this.

---

* Mr Edward Hughes states, "Plenty of shad came up before the erection of the navigation weirs, and brought from 8d. to 1s. per lb.; and a fisherman would take as much in a night as 20 or 30 lbs. of flounders, worth about 6d. or 8d. per lb. Lampreys are entirely gone,—we see nothing of them."—Min. of Evid., 1861; No. 8413, *et seq.* Flounders were taken as high up as Lord Powis's weir.

Such is the simple story of the Severn. The finest river in England is nearly ruined by building walls across it, sufficient to stop everything except a large and powerful animal, whose instinctive energy to continue its race forces it through everything that will admit its body. Yet, notwithstanding, there is no river affords more hope than the Severn, were its restoration properly taken up. The whole character of the river and its tributaries is favourable,—a large body of water, deep pools, and abundance of spawning ground exist, and there is yet no pollution from mines. We have already mentioned the quantity of large salmon taken in former days at the beginning of February in the lower part of the river, and Mr Shaw told us that one year he knew thirty-three large salmon taken in the month of January above Shrewsbury. Looking at the large size of the salmon mentioned, and some of them having been taken so far up, the Severn would become a most valuable river at the early part of the season, could anything like an easy passage be given to the fish.

Grilse are now very scarce, which is accounted for by its being impossible for them to surmount the high navigation weirs at a season when the supply of water is generally low. A great variety of other fish are abundant in the Severn. Grayling, perch, gudgeon, ruff, and all the ordinary Cyprinidæ, —these formed a great assistance to the food of the humbler classes, and unless very great abuse occurred, such as killing the fish by poisoning, or such-like, there would be an ample supply for all. Flounders, eels, shad, &c., were seen to have been formerly abundant; these yielded revenue to the fishermen; but we do not see that they can now be carried over the navigation weirs, or ever restored to their previous numbers.

During our examination of the Severn, some circumstances were brought to our notice which are of considerable importance, and are worthy of attention. The emptying of gas works was generally much complained of; but an examination into the circumstances led us to believe that the ordinary refuse, except in extreme abundance, or in very dry weather and a low state of water, was not actually fatal to the fish. The oily-looking matter floating on the surface would spoil the sport of the angler. But the ammoniacal liquor, or the clearing out of a gasometer, is fatal, especially in very low water. As the tar from gas works is of some value, and the ammoniacal liquor can in the larger establishments be made very profitable by the manufacture of sulphate of ammonia,—and some of these are ready to purchase that liquor from smaller establishments, which cannot afford to erect the necessary apparatus for themselves,—there is no necessity for allowing any portion of the refuse to escape. This is one of those cases in which the law should be enforced, and conservators should be directed to look very narrowly, and to compel the companies to make money of their refuse, and so assist their shareholders.* That a flavour (which comes strongly out when cooked) can be imparted to fish by the mixture of substances with the water, was fully made out by the evidence given on several rivers ; and it seems more easily imparted than at first imagined. Such may be the case when we hear it said that salmon or trout has a "muddy flavour," &c. It was proved that salmon in the Severn had "tasted of tar." The flavour was brought out on being cooked, to such a degree that the fishmonger took back the fish, and gave others instead; he "tasted the tar himself throughout the fish from head to tail ;" and the salmon, before being sent away, had every appearance of being perfectly good. This circumstance happened during the year that some creosote works were working and discharging refuse into the river. The same fishmonger had two lampreys returned to him that tasted strongly of tar, but this he attributed to their being placed in a newly tarred boat, and sucking on to the sides with their mouth. At one time a boat laden with tar in casks had been sunk, and the casks were broken or burst while endeavouring to raise them up. White fish, flounders, &c., taken round this tasted of tar when cooked. Creosote works, and discharge from them, or the escape of the "pickle," as it is termed, from the casks, also produce this taste, and kill fish; for in the River Parrett we found a similar complaint, and both salmon, eels, and flukes tasted of tar when boiled.

---

* Mr De Vitre, chairman of the gas committee of Lancaster, states, "The ammoniacal liquor is a profitable part of the business ; it pays very well for manufacturing it, *and it obviates the necessity of getting rid of it elsewhere.*" "We should be glad to take any quantity of ammoniacal liquor to aid our operations in making sulphate of ammonia." — Min. of Evid., 1861, Nos. 9468, 9477.

In the Severn and in various other rivers it was stated that the gudgeon, roach, and dace, &c., fed upon the salmon spawn, and their destruction or curtailment was often insisted upon as essential to the restoration of the rivers. This could not be brought to any test; no one had seen these fish taking the spawn, or had ever found it in their stomach. Gudgeon take minnow "savagely," and therefore the salmon fry were the most tangible and logical evidence of the fact we could procure. Nevertheless this is worth investigating. None of the fish mentioned can take up the roe from the spawning-beds; and any that may be caught when the salmon are in the act of depositing it, is unimpregnated and useless; but it is possible, in rivers abounding with the Cyprinidæ, &c., that they may know of and watch the spawning-beds when the ova are in the act of development, and seize the young as they come to the surface of the gravel, or while they are still helpless. It is worth while to ascertain whether such is the habit of any of what are termed "coarse" fish. Not by any means that we advocate their destruction for so doing. Some people advocate the killing of common trout, because they will take salmon fry; on the same principle may be advocated the killing of all the old salmon, because no bait is more successful for them than a small samlet. All the pike should be killed, says one,—all the eels, says another. We had a note a short while since, declaring war upon all seals and porpoises, &c. Now, if you kill all the trout, you leave myriads of aquatic larvæ which trout prey greedily upon. These larvæ are carnivorous, and are known to feed on the ova of fishes; kill all the pike and eels, and you will have the Cyprinidæ more than ever abundant; kill all the Cyprinidæ, and you leave nothing for the pike but young trout and salmon fry; kill both pike and coarse fish, and you force salmon to become cannibals and feed on their own offspring. If you make war upon the seals and porpoises, what curtails the shoals of hake, &c., that crowd the mouths of the estuaries, and take a large proportion of the young fish as they leave the river? Man loses sight of himself as the *great destroyer*, and in his ignorance tries to interfere with God's own arrangements among His creatures, and with the beautiful balance everywhere established.

All animals have their parasites; these, when in excess, whether from any particular state or condition of the animal, or other cause, are then injurious, and even cause death. Among fishes parasites are very common, both external and internal; and among the migratory species one series is found upon them while in the sea, which is supplanted by others on their entering the fresh waters. In a few cases vegetable or fungoid growths appear, which was specially the case in 1859, when the pools became stagnant and heated, and the water very low. It attracted the attention of the fishermen, and it was also observed that the small fish, kept in tanks for bait, were at the same time attacked with it. When endeavouring to elicit the causes for the diminution of the different kinds of fish in the Severn at Shrewsbury, and where all were anxious to give as much information as they could, two circumstances were mentioned that were thought to have assisted particularly in the diminution of the grayling, which Mr Shaw stated had of late been considerable. It was stated that some small parasitic animals attacked salmon, trout, grayling, and other fish. They stuck to them, as many as twelve, twenty, or even forty.* These could be scraped off the fish when caught, "and when put into a pan they fight until they kill each other." Four or five years since these were very abundant, and last year (1860) they had again occurred in considerable numbers. Unfortunately, we have hitherto been unable to procure specimens of these parasites.

The Wye.

The River Wye, &c.—Our first sight of the Wye was at Monmouth, a town of ancient record, though not famed for its architecture, and perhaps not the best point at which to introduce a stranger for the first time; but to see salmon, not scenery, was our object. The time for tourists had nearly gone by, and the old bridge was more than usually crowded with lagging boatmen anxious to be hired to fish, or visit Tintern or Chepstow, as best suited time and inclination. Below, boats and barges, of manifold kind and form, were ready to convey parties of two or twenty whithersoever they wished, and in mid-stream plied four or five coracles taking "skirling."

---

* "It was something like lice upon salmon, and stuck to the outside of the fish and ate holes in it."—Min. of Evid., Mr H. Shaw, No. 8648.

The influence of the tide is felt nearly as high up as Monmouth, by the damming back of the water, and between that town and the sea there are no fixed engines or artificial obstructions whatever. The greater portion of this lower part of the river, extending about twenty miles in length,* belongs to His Grace the Duke of Beaufort, who appears to draw only about L.120 yearly from it; and when we look at this long stretch of a noble river, and contrast the Duke's rental with those drawn from the Tay, Spey, and some other Scotch rivers, we naturally ask what is the cause for this difference? It forcibly struck Her Majesty's Commissioners, that until the north of England and the Border are reached, none of the English or Welsh rivers produced a rental of any magnitude. There is nothing like L.4000 or L.5000, or L.10,000 or L.12,000 a-year ever drawn from any salmon river there, and there were, and in some parts there still are, large quantities of fish. The proprietors or their agents do not seem to understand the salmon fishery question, nor to have looked upon their rivers as capable of producing any considerable income. The weirs and fishing traps are let at almost nominal rents. But somebody, even in the reduced state of the fisheries, must be benefited, and it is possible that in several cases the proprietors are humbugged and plundered, and the public property and interest at the same time severely injured. Ignorance and inattention to the subject on the part of principal and factor, jealousy between upper and lower proprietors, and consequent want of co-operation, which in time beget illegal fishing by every means, are undoubtedly, on the Wye, the prominent causes of deterioration and exhaustion.

A stranger, accustomed to the clear streams of the North, who visits the Wye at Monmouth for the first time, is struck with the colour of the water and the mud held in solution: and he thinks this the more remarkable, as the river rises in a high and mountainous district. The water is of a muddy green colour, and the shallow parts are much filled with large patches of weed, often of extraordinary length, and appearing very conspicuous from the bright red colour of the stems. Having heard much of its over-fishing, we were anxious to see its capabilities, and resolved to journey between Monmouth to Chepstow by water. The night had been rather rainy, and the boatmen said a "little fresh was on," which contributed to the increased muddiness of the stream. Frequent rises indicated the presence of the "skirling;" and in the beautiful looking pool above the railway bridge, a perfect specimen of an old Wye fisherman was seated in his coracle, his rod over one side, and his line in hand with ten or twelve hooks baited with maggots. This he was just about to let loose, and so to ply his daily trade of killing young salmon for his livelihood. Down we proceeded through grateful, pleasing, quiet scenery, through many a stream and pool, which would tempt the most apathetic angler, but in which we were again and again informed it was needless for him to ply his art. Salmon are said not to be taken now in these waters with any fly or bait; but what the reason is, without trial or experience we can scarcely say, unless that the fish are disturbed by the constant boating and coracle net-fishing, and do not get settled. Many of the places for "bush-beating" were pointed out; and now and then some fisherman stood perched upon a sod watching his float, as if on it depended his breakfast, standing as silent and motionless as a heron upon her watch. Down we rowed, without much change of character, until below Tintern Abbey, where the river becomes more muddy, the thickness increasing as we proceeded, until the water becomes really thick, impenetrable to any eye. The passage down is made pleasantly and conveniently, especially if the party are numerous and the luggage considerable. The expense is L.1.

---

* Min. of Evid., 1861. Mr Wyatt, No. 930.

The Wye, Usk, and rivers running into the northern side of the Bristol Channel, are peculiar, somewhat resemble each other, and nearly the same modes of fishing are practised in them. The Wye is a large and noble stream, and possesses every requisite for a salmon river ; like the Severn the tide has a very high perpendicular rise, and flows up nearly to Monmouth, but the tidal portion scarcely anywhere assumes the character of an estuary ; it is narrow, above Chepstow becoming almost a gorge bounded on each side with limestone cliffs. This is filled periodically with a deep muddy tidal stream, which at low water leaves steep sludgy banks, in many places unfit, or at least inconvenient, for using a draught net or seine. The muddy water here renders nets of different kinds temporarily fixed during a part of the ebb or flow of the tide efficient, and it is by means of these that the salmon fishing in the lower part of the Wye is almost entirely managed. The ancient mode of fishing by coracles is much in use; but this is not confined to the tidal waters only, and it is more extensively practised in other rivers to be mentioned afterwards. The most productive mode of fishing, and that which is carried on to the greatest extent here and in the Usk, &c., is called "stopping," or "stop-net fishing," in other parts "compass nets ;" it is, in fact, the peculiar mode practised in this system of rivers, and is almost confined to them.

At the commencement of the ebb or flow of the tide, a large boat is moored by anchor, and fixed by long sharpened iron-shod poles in what is supposed, or rather by experience is known to be, the "run of the fish." A large bag net, on a frame of from 25 to 35 feet beam, capable of being easily raised by the fisherman, is let out upon the side next the ebb or flow, so that the bag is carried out by the tide underneath the boat. The fisherman with one arm leans on the angle of the frame ready to act, and has the loop of a cord attached to the bag of the net round a finger of the other hand. The slightest interference with the net is felt by the looped finger, and when a salmon strikes, the net is quickly raised and the fish secured in the bag. At suitable states of the tide numerous boats may be seen going out prepared to "stop," and ply their precarious fishing. The stations are taken up by turns, some being considered more certain than others, to allow the men an equal chance. These fishings are generally sub-let, the lessee of the fishery sometimes supplying boats and nets, and paying the men according to the quantity of fish taken, or a certain agreed-upon proportion of the price. It is a mode of fishing, however, far behind the present time and invention, and the boats and nets necessary for it must require very considerable capital. It is, moreover, uncertain, and occupies a large portion of time compared with the quantity of fish taken. There is nothing particularly injurious to the fisheries in the use of these engines if fairly employed, and any unseasonable or old fish may be easily set at liberty uninjured. At the same time several boats are sometimes set in line, and then they form greater barriers to a clear run; but as it is only for a few hours at the flow of the tide, or after it has partially ebbed, that this kind of fishing can be practised, it can scarcely be looked upon as a serious obstruction. At Chepstow we were initiated into all the mysteries of this fishery by the attention of Mr Sargent, who is the lessee; besides his evidence taken publicly, he gave us privately every information in his power. We saw and went on board the stopping boats, and had the good fortune to see a nineteen-pound fish captured by one of them. Mr Sargent holds his fishing on lease from the Duke of Beaufort. The general mode of letting is to tacksmen from year to year, but in some cases, as in that of Mr Sargent, leases from five to seven years are granted. These leases, drawn by the Duke's agents, contain very stringent conditions for preservation of the fish, and against breaches of Fishing Acts; but still no attention seems to be properly given to see that these are observed, and they as well as the Acts of Parliament are unheeded. The great abuse here, and especially about Monmouth and Ross, is that of killing in spring the young fry, called here "pinks," on their way to the sea, and at other seasons the "skirlings" or "skerlings"—the *parr* of the Scotch rivers. This is done to an extent we had no idea of. Monmouth is the Woolwich of Wales, parties come from a distance to eat salmon pink. They are ordered for breakfast and dinner, and pink and skirling here hold the place of whitebait. Boats are hired by tourists for the express purpose of fishing these; it is a trade and profession by which many of the boatmen and fishermen live and make their livelihood. Tradesmen and lads all fish for them, and easily obtain a light meal; and regular traders hawk them about, call at private houses, and bring them to the hotels. When the "skulls" of fry are going down to the sea, the boatmen race after them, to have the first throw; and when they rise to the surface they are so numerous that they are taken by the hooks being drawn through among them. This is the regular employment of the coracle men, who all fish with ten or twelve hooks on one line baited with maggots, and so many as four hundred are known to have been killed in a day by one rod; and besides, in spring and early summer it is computed that not less than two hundred fishers go out daily, who may take, on a low calculation, from one dozen to twenty fish a-piece.

There is no doubt that these skirlings or skerlings of the Wye are identical with the much disputed parr of the rivers of Scotland. It is equally without doubt now, that these small fish, destroyed in such numbers, are the young state of the salmon; and it may be proper here to place the *parr question* in what we consider its right position, —more especially as we may have assisted in continuing the view still taken by some, that there DOES YET EXIST *a parr*, a veritable and independent fish, breeding and continuing its own race. We need not go very far back in its history; but since the different kinds of British fishes have been separately described and recorded, the parr has been regarded by authors either as a species, or a variety, or a young fish. It is described by Ray in the first book of Willoughby's "Ichthyology" as the *Salmulus*, "Herfordiæ samlet dictus;" and is afterwards noticed in the Synopsis of Fishes, where the distinctions between it and the common trout of the same size are pointed out. Pennant, who was well acquainted with the Wye and the Severn, describes it as the samlet, and expresses his dissent from those who hold it to be young salmon; and as some of his reasons, he states that "the samlets are found, male and female (distinguished by the milt and roe) of the common size," that they spawn in November and December, "at which time those of the Severn push up towards the head of that fair river, quitting the lesser brooks, and return into them again when they have done."* Mr Pennant does not state the circumstances as from hearsay, but as facts. To this great Welsh author we are indebted for many valuable works relating to the natural history and antiquities of this country. He devoted a great deal of his time and talents to the study of these branches, and we ought therefore to be cautious in contradicting the two assertions quoted above. But in all our wanderings among lakes and rivers, and from all our inquiries, we have never seen, nor been able authentically to learn, that such states of the parr, under any circumstances, existed. In our recent tour of inspection of the rivers in England and Wales, we were frequently told of parr or skerlings having full-sized ova in them; but all offers, from half-a-crown to a sovereign, failed to produce them.

Difference of opinion on this subject existed up to 1834. In that year, accompanied by Mr Selby, James Wilson, and some other friends, all keen fishermen, we made an extensive tour through Sutherlandshire, attending to its natural history in nearly all its branches; and at the meeting of the British Association at Edinburgh in that year, a paper was read on the "Salmonidæ met with during an Excursion to the North-west of Sutherlandshire," which was afterwards published in this Journal, then so ably conducted by the late Professor Jameson.† The paper, with some additional remarks, was also printed in the "Transactions of the Berwickshire Club."‡ In these the parr is treated as a *distinct species*, its characters are pointed out, and it is stated that the part of its history "yet unknown" was its breeding. At the Edinburgh meeting, the fishes procured in Sutherland were exhibited, and specimens of parr and young trout from the Tweed, Annan, and other rivers, were also produced. M. Agassiz was present, Dr Fleming, Dr Parnell, and others. The icthyologists of Section D were fairly puzzled, and the result of the discussions, I believe, was expressed in the following sentence, which has been quoted so lately as the last year, for the purpose of supporting the view that there is a veritable *parr*. The sentence alluded to is: "The difference of opinion among all our ichthyologists, or rather, the difficulty which they appear to have in forming one, whether this fish (the parr) is distinct, or only the young of some others, has rendered the solution of it interesting. The greatest uncertainty, however, latterly resolved itself into whether the *parr* was distinct, or a variety, or young of the common trout, *S. fario*. *With the migratory salmon it has no connection whatever*."* The subject continued in this state, with various undulations, until 1836, when the experiments of Mr Shaw were detailed to the Royal Society of Edinburgh. The young dress of all animals varies from that of the adult; but the changes are more marked and decided in some groups than in others. Among some birds these are very remarkable; and many will yet recollect the controversial papers in the late George Montague's time, and those by Mr Selby and James Wilson, in regard to the changes put on by the Golden and Ring-tailed eagles, the Hen Harrier and Ring-tail, Gooseander and Dundiver, &c. These were settled beyond dispute by the birds being kept in confinement from the nest to maturity.. This proof was not so easily obtained with fishes: procuring authentic ova or young was a serious difficulty, but Mr Shaw set himself to rear and keep the young of the salmon. He first procured young fish from the streams by means of a hoop-net, and afterwards he took the ova from a spawning-bed in which he had seen what he considered to be true salmon depositing their spawn; and having removed them to an undisturbed and suitable locality, he succeeded in hatching them, and bringing them forward to the time when the salmon fry began to take their departure to the sea. He produced parr in his ponds at Drumlanrig; but when exhibiting the specimens, of the genuineness of which in every respect he had no doubt, and in fact most of his hearers had none, he was met with the query, "How did you know that the small fish were the young of the salmon, or that the ova you took from the spawning-bed were deposited by salmon?" The flaw in the proof was evident, however well satisfied he might be that he was correct. The case was not proved in such a way as to refute previous opinions. These objections were obvious to Mr Shaw, and notwithstanding the time necessarily required, eighteen months or two years, he started at once to perform his experiments again in such a way as to remove all doubt of the identity of the parents. Mr Shaw captured two fish in the act of spawning—a male and female—at one cast of his hoop-net, took them on shore, artificially impregnated the ova, killed the parent fish, and produced the specimens, along with their young, at a future meeting of the Royal Society. This was unanswerable, and the young were without doubt parr. The experiments in the ponds at Stormontfield on the Tay have confirmed the same facts; and any one who will insist now that a parr is not a young salmon, must have some warp in his intellect, not to be removed by any possible demonstration. Mr Couch of Polperro, an intelligent naturalist, has last year written a paper "On the Natural History of the Parr," and he still considers that fish to be distinct. He founds his opinion upon the circumstance, that in a basket of fish taken from a tributary of the River Fowey, in the month of January, "the examples (of parr) that measured six inches were severally supplied with milt and roe fully developed, and ready to be shed." A figure was taken of the milt, but "accident prevented the roe from being dealt with in the same manner." This is to be regretted, and also that specimens of the females were not preserved in spirits; for without doubting Mr Couch's ability to distinguish, if the specimens do not exist, his statement is liable to the same query as Mr Shaw's first experiments, Are you quite sure that these fish which you examined were parr, or the young of salmon? But allowing them to have been parr, Mr Shaw tells us that solitary instances have occurred of large female parr having been found in salmon rivers with the roe considerably developed; and when female smolts were detained in fresh water, until the end of the third winter, the individuals were found in comparatively mature condition.* The occasional appearance of a parr with fully developed roe is merely a proof that such sometimes takes place, and cannot affect the other fact, observed in innumerable instances, that the fish hatched from ova produced by salmon are parr.

---

* Pennant, Brit. Zool., edit. 1812, vol. iii. p. 405.

† Edinburgh Philosophical Journal, 1834, p. 46.

‡ Vol. i. p. 82.

---

* Edin. Phil. Jour. 1834, p. 57.

---

* Trans. Royal Soc. of Edinburgh, vol. xiv. p. 564.

As we ascend the Wye, unfortunate destructive practices prevail, notwithstanding the interest shown by many parties, and the institution of the Wye and Lugg Association. At Hereford there is a fine reach of the river below the bridge, the fishing of which belongs to the bishop, who liberally lets it to assist the Association, and pays over the rent—L.10—as his subscription. A good view of this fishing pool is seen from the window of the little Museum, erected close to, and, indeed, overhanging the river. This building and room are very neat, but the Museum is, as usual, a confusion of a very little of everything, and in want of local productions; how interesting a collection of the river fish would be in their different states, and with the *local* names attached to the specimens! A fishmonger here invited us to see some salmon killed that morning (20th September), as specimens of fish in fine condition. The one was a large kipper, with hooked under jaw and bright red colour; the other a female full of spawn. These salmon would have spawned within the week. Our friend had a large shop, and was no second-hand dealer, and we could not but hold him ignorant of "condition," or of the impropriety of encouraging the destruction of such fish, from the innocent manner in which we were invited to inspect them. Samlets here are also enjoyed by travellers and tourists, and are openly hawked about and sold to the hotels. Skerlings are taken by the peck, and so sold. They are taken from a boat with three rods, having seven or eight hooks on each line, which are dragged and re-dragged across the river. Even respectable persons in charge find an excuse; and a gentleman's gamekeeper, when asked if he allowed gentlemen visiting to kill "last springs," replied, he did not permit it—"only a dozen for Missus." Higher up the river fly-fishing still continues a regular trade. One fisherman acknowledged killing 300 in one day, and did not consider himself paid if he caught less than 200. The selling price is 6d. per lb. This is called poaching by a great many persons and proprietors, but they have no right to do so—the proprietors who buy, or allow their housekeepers to do so, and the gentlemen who eat, are the poachers. So long as they create a demand there will be a supply, until the fish are extirpated; and it is ludicrous to hear a well-got-up landowner, possessed of a regular anti-poaching fever, inveighing against "poaching, and the blackguards that infest the river," while he himself cannot want samlets for breakfast. It might be well, in a new Act, that fine should be the punishment of taker and seller;—imprisonment, with or without hard labour, that of the buyer, if he owned a reach of river.

After leaving Hereford, the river begins to assume more of an angling character. Netting is more rarely practised from the nature of the river. In winter the usual modes of poaching are much followed, if it can be so called, for it is done openly, and by the farmers and their sons, who claim a sort of right to the fish that come up there. They are so taken to be salted, or otherwise cured, for the use of the family; but a spirit of retaliation for the fish being kept down during the open season, and nowhere allowed to ascend, also mingles in the desire for the unseasonable sport. In addition, the mining population at Rhyader, of Rebecca notoriety, gather in large bodies, and sweep the fords of the spawning fish. This has been done almost every year; and a short time after we had left Builth, one of these marauding parties had killed considerable numbers. On several of the tributaries this winter destruction is carried on to a great extent; in some of the smaller streams, it is asserted that "none return," and so sweeping is the destruction, that a "last spring" is scarcely to be seen. Notwithstanding all this, the reputation of the Wye is increasing, and higher rents are being given for its angling waters. Various clubs and associations have been formed, anxious to protect the river; but the co-operation of all parties is not cordial. By and by, when the advantages are known, we may hope for a better state of things.*

---

* At a meeting of the subscribers for the upper part of the Wye and its tributaries, held at Builth, this want of co-operation is seriously appealed to. The lower proprietors contribute a small proportion to the funds for preservation, and as they reap the first-fruits of improvement, from the care taken of the breeding-grounds, the upper proprietors feel this, and there is difficulty in getting them to continue their subscriptions. After the Report has enumerated various illegal modes of killing fish, it concludes, "One other species of destruction deserves notice, namely, that caused by otters, of which no less than sixteen have been destroyed by Mr Greenwood's keepers during the last three and a half years, and the committee trust that all gentlemen who have fisheries

In the Bristol Channel river system, the Usk is next in importance to the Wye, running a course of from seventy to eighty miles in length, and having a watershed supply-basin of 650 square miles. It has always been a celebrated salmon stream, almost more so than the Wye, and its properties are frequently noticed by the early poets. Churchhill says—

> "Great store of fish is caught within this flood,
> That doth indeed both town and country good."

Fifty or sixty years ago, old women went about the streets of Newport hawking salmon cut into "gobbets," and boiled, which they sold at 2d. the pound. In natural characters the Usk much resembles the Wye, and at Newport is a large muddy stream. This detracts much from river associations; and beautiful as the scenery is in many parts of these noble outlets, the muddy water breaks and mars it. Resembling the Wye, it is fished by similar engines, and has of late years somewhat recovered the great destruction and waste which was carried on in many parts. The usual modes of illegal fishing are carried on, and as the upper part of the stream runs through a dense mining population, there is a ready market there, whatever the condition of the fish may be. The farmers and their families also fish and spear in close time, and there is the feeling to kill all, "as they will not get back again." From ten to twenty foul fish are frequently taken together by these family parties, which are used by the household. The mode of dressing is peculiar. The fish are cut up and put into a large pot, and boiled in milk. They are served up warm, and said to be much relished. If the mining operations towards the source do not increase, and become very deleterious, there is nothing to prevent the Usk being restored as a salmon river. There are no great weirs, as on the Severn. The Trosky weir, much complained of, was originally of "brush," and now, even with amendments, is easily passed.

---

will assist in checking the increase of the animals." Mr Greenwood's keepers had better let the otters alone; if very numerous, there might be some reason for curtailing their numbers, but sixteen in three years and a half would point to the reverse. Otters do not live exclusively on fish, and in a stream where they are very numerous, we know of no injury done, and there is abundance of fish. The otter unfortunately comes under the head of keepers' "vermin."

Description of a New Species of Clerodendron *from Old Calabar, which flowered in* 1861, *in the Royal Botanic Garden of Edinburgh.* By JOHN HUTTON BALFOUR, A.M., M.D., F.R.S., Sec. R.S.E., F.L.S., Professor of Medicine and Botany.* (Plate II.)

The plant which I am about to describe was transmitted in a Wardian case to the Botanic Garden some time ago by the Rev. W. C. Thomson, one of the United Presbyterian missionaries at Old Calabar, on the west coast of Africa. It produced flowers in the hothouse in December 1861. The plant has a very showy appearance in the conservatory, twining along the roof of the house to the extent of ten or twelve feet, and giving off numerous clusters of flowers. The contrast of colour presented by its white calyx and crimson corolla render it a desirable plant for cultivation. Along with the plant, Mr Thomson sent a few notes and a rough pen-and-ink sketch of the flower. He also expressed an opinion that the plant was new, and if so, he wished it to be named after his late wife.

The plant belongs to the natural order *Verbenaceæ*, and appears to be an undescribed species of *Clerodendron.* I have therefore denominated it *Clerodendron Thomsonæ.*

Generic character.—CLERODENDRON† (L.)

Calyx campanulatus, rarius tubulosus, interdum pentagonus et subinflatus, 5-fidus vel 5-dentatus, rarissime truncatus. *Corolla* infundibularis vel subhypocraterimorpha; tubo sæpissime calycem conspicue excedente, interdum longissimo; *limbo* 5-partito, laciniis superioribus paulo magis approximatis, subinæquali, vel laciniis inferioribus magis minusve adscendentibus, obliquo, immo subsecundo. *Stamina* 4, corollæ tubo inserta, longe-exserta, subdidynama; *antheræ* supra basin insertæ, basi fissæ, biloculares, *loculis* parallelis, rima

---

* Read to the Botanical Society of Edinburgh, 9th January 1862.

† From κληρος, lot or portion, and δενδρον, a tree. The name is given to the genus in allusion to the salutary or dangerous effects of the different species which constitute it. Thus *Clerodendron fortunatum* is useful in medicine, while *C. calamitosum* and *C. infortunatum* are the reverse.

longitudinali dehiscentibus. *Ovarium* 4-loculare, loculis 1-ovulatis; *ovulo* in spermophoro angulo centrali adnato, pendulo. *Stylus* filiformis, exsertus, stigmate bifido acuto. *Drupa* calyce ampliato insidens vel inclusa, baccata vel carnosa, quadri- vel sæpius abortu mono-di-tri-pyrena, sæpius 2-4-loba, *pyrenis* maturitate distinctis unilocularibus, *putamine* lignoso lævi. *Semen* solitarium, erectum. *Cotyledones* oleosæ, applicitæ; *radicula* brevis, infera.—Frutices *vel* arbores *inter tropicos veteris orbis, imprimis vero* Asiæ, *copiose, in* America *vero parce crescentes.* Folia *opposita vel terna, simplicia, integra vel rarius lobata,* phyllopodio *interdum prominenti persistenti insidentia.* Cymæ *trichotomæ vel axillares, vel in paniculam terminalem collectæ.* Schauer.

I. Euclerodendron.

Corolla hypocraterimorpha, tubo calycem subæquante vel majus minusque excedente (pollice vix unquam longiore) limbo patente vel subsecundo.

Specific Character.—Clerodendron Thomsonæ (Mrs Thomson's Clerodendron).

Caule volubili glabro, foliis oppositis brevi-petiolatis integris oblongo-ovatis acutis glabris, venis superne sulcatis, panicula axillari et terminali, cymis dichotomis laxifloris bracteatis, calyce albo membranaceo inflato pentagono 5-partito laciniis ovatis acutis, corolla coccinea, tubo gracili extus glanduloso-pubescente calycem æquante, limbo obliquo 5-lobato, staminibus longissime exsertis.—Frutex volubilis crescit ad ripas fluminis *Old Calabar* in Africa occidentali.

A shrubby twining plant. Stem terete, of a light gray colour, bearing numerous lenticular warty excrescences on its surface; branches twining extensively round other plants or prostrate and rooting. Leaves dark green, mostly opposite, exstipulate, oblong-ovate, acute, entire, glabrous, margins slightly reflexed; reticulated in venation, midrib prominent below, two lateral ribs coming off from the base of the midrib, all the ribs and veins grooved on the upper side; largest leaves about nine inches long, and from three to three and a

half inches broad. Petiole short, about one-fourth of the length of the lamina. Inflorescence chiefly axillary, cymose, dividing dichotomously, with two small linear bracts at the division of the cyme; flowers placed in a secund manner on the stalks; peduncles and pedicels pubescent. Calyx gamosepalous, hypogynous, thin, flaccid, membranaceous, persistent, large and inflated below, narrowed above, of a pale whitish colour, with greenish veins here and there, extending a short way from its base, which is also greenish and is closely applied to the ovary, after the fall of the corolla assuming a dingy purple colour, æstivation reduplicate, five projecting angles at the union of the sepals, with depressions between the angles, divided about two-thirds down into five segments, which are ovate-acute and tipped with green. Corolla gamopetalous, with imbricate æstivation, at first completely enclosed within the large calyx (which is developed very early, and long before the corolla), afterwards the corolline limb extending beyond it; tube long, slender, equalling the calyx, covered with glandular hairs, pale-coloured, and slightly reddened at the upper part; limb of a fine crimson colour, presenting a remarkable contrast to the white calyx, irregular, of five short, unequal, oblong-ovate blunt segments, the lowermost being the longest, the two uppermost separated from each other by a marked notch, through which the stamens project. Stamens four, didynamous, much exserted, being twice the length of the corolla, in æstivation coiled up spirally and retrorsely; filaments pinkish below, pale above, inserted about the middle of the corolline tube; anthers grayish-yellow, two-lobed, introrse, attached above the base, dehiscence longitudinal. Ovary of four concrete carpels, with a central placenta, 2–4-celled, surrounded at the base by an annular disk; style apicilar, long, filiform, shorter than the stamens, but longer than the corolla, becoming finally slightly curved backwards; stigma bifid. Fruit* of two, three, or four achenes, with a fleshy, rugose, bright scarlet substance resembling a one-sided aril, which is developed after the fall of the style. Cotyledons epigeal.

---

* The characters of the fruit are taken from Mr Thomson's notes. The plant has not borne fruit in the Botanic Garden.

Mr Thomson states that the plant grows abundantly on the banks of the Old Calabar River above salt water range.

Description of Plate II.

Fig. 1. *Clerodendron Thomsonæ* (Balf.). Showing its twining habit, oblong-ovate usually opposite leaves, short petioles, axillary panicles of cymose flowers with inflated calyx, oblique 5-lobed corolla, and exserted stamens. The figure does not show clearly the grooving of the ribs and veins on their upper surfaces.

Fig. 2. Calyx removed, and tube of corolla opened to show insertion of didynamous stamens, concrete ovary, apicilar filiform style, and bifid stigma.

On the Geological Age of the Pagan Monuments of the Outer Hebrides. By Capt. F. W. L. Thomas, R.N.*

Some recent observations made upon the geological changes that have taken place since the so-called Druidical circles were erected in the Long Island, will, it is presumed, be interesting to the Society; although any conclusions from these observations can only be valued as first approximations to a knowledge of the era of the unknown founders of these gigantic monolithic structures.

It forms no part of the present subject to describe these monuments farther than to state, that, as in the Orkneys, in one locality of the Lewis several of these circles are placed within a short distance of each other; but no peculiarity is observable in the selection of their position; and, from all that is known at the present time, their place of site appears to be accidental, or at least chosen without any distinct motive. One of these circles, the far-famed stones of Callernish, occupies the flat of a ridge of hilly ground, while two others are near together on a wet and boggy moor, at the distance of a mile to the eastward of the first. If the circles situated on the moor had been visited two or three years ago, nothing but a few gray blocks even with, or protruding two or three feet above the bog, would have been seen, and even many of the stones of the large circle of Callernish were completely grown over and buried in peat. By the liberality of Sir J. Matheson these three circles have been excavated, and it was then found that the peat had accumulated to the height of between five and six feet. From an attentive examination of the foundation of these circles, I arrive at the conclusion that the stones were pitched before the growth of peat had commenced, or at least at the very commencement of the peat-forming epoch. The upright stones are founded in the (so called) boulder-clay which overspreads this, with most other parts of Scotland, and the peat rises uniformly from the clay to the surface, which would not be the fact if holes had been dug in the peat to receive the stones. Besides, some stones that had early fallen (in the smaller circles) rest upon the clay without any peat below them; and still further, in two of these circles are loose heaps of stones,—"cairns," as they are called, the grave-mounds of the illustrious dead,—which also rest upon the clay, without any intermediate floor of turf. If any peat had grown, it would be found beneath these cairns, for I consider it childish to suppose that it would have been cleared away. At the excavation of a tumulus at Stennes, in the Orkneys, which was presumed to be of or about the same age as the adjacent stone circles, the heath and moss on which the materials of the tumulus had been heaped were found in as good preservation as when the mound was made.

---

* Read before the Royal Physical Society on Wednesday, 26th Feb., 1862.

Besides the circles named, there are others, both in Lewis and Uist, which are only discovered by an occasional stone peering above the surface; and I see no reason to doubt that some of these Pagan monuments are entirely buried and out of sight.

I produce a stereoscopic photograph of the Callernish circle, which fortunately shows, by a difference in the depths of shade, the height to which the peat had grown around the stones; two of them, to the left hand, were entirely covered.

If, then, it is admitted that the stone circles of the Lewis were placed before, or only when the peat began to form, and that the peat has grown five feet since that time, it is evident that the least age of these monuments would be known if the annual increase of peat was known. But I am unacquainted with any data from which to form an estimate, and there is a wide difference in the opinions held on that point. One practical gentleman assured me that the Lewis peat grew an inch every year; at this rate the entire deposit might have taken place in about sixty years. Another estimate is nine inches in a century, but we require twice the number of years that this ratio would give to get back to Pagan times. As I am unacquainted with any class of facts that bears upon the subject, it is not worth while to offer any conjecture at the present time. I may mention, however, that to my surprise, one of the Lewis bards has a tradition that at one time there was no peat in Lewis; and it is also to be noted, that almost always on excavating any of the Pictish dwellings pieces of burnt stick (charcoal) are found at the fire-hearth. I do not wish it to be inferred, however, that there was no peat to be then found—only that sticks formed part, if not all, of the fuel then in use. A most instructive section was made a few years ago on the banks of the Creed, in the policies around Stornoway Castle. My notes are mislaid, but if my memory is correct, a cutting was made through a peat-bank to form a road, by which a perpendicular section of between eight and nine feet in height was exposed. About the middle of the bank, that is, three or four feet below the surface, was and is the place where a fire had been kindled, a few stones had been put round on which to stand the kettle, probably to boil a salmon, and bits of charcoal still remain in the ashes. The banks of the Creed could still supply enough indigenous birch to boil a craggan.

Very erroneous opinions are abroad concerning the cause and growth of peat; in most books I see the observations of a certain Lord Cromarty are quoted, from which it is most illogically inferred that all peat is the result of the decay of forest trees. So wide spread is this allusion, that it has been quoted to me where the peat-banks were visibly and presently telling their own history. Without denying that the decay of forest trees in marshy ground will form peat, it requires only the most superficial observation to know that wood peat occurs only in the most homœopathic quantity in, at any rate, the islands of North Britain. It fortunately does occur as an exceptional instance, and then in so marked a manner as to leave no chance of confounding wood peat with the almost universal moor peat. The bulk of the peat of the northern and western islands is made up of the roots of rushes and moor-grass; the mosses help to keep it constantly wet, and the tormentilla (and probably other plants) supplies tan to the moss, and prevents it from decomposing into vegetable earth. Such were the conditions when the peat first began to grow, and such they still continue. I have looked over thousands of sections of peat banks in which there was no difference in the composition of the peat, from the base where grew the first peat-forming plants to the surface at the present moment, excepting consolidation towards the bottom from time and pressure. When the surface of a peat bank has been exposed for some time to wind and rain, the most solid, as well as the spongier portions of the peat will be found disintegrating into laminæ, which laminæ probably represent the annual growth, and if they were distinct enough to be counted would indicate the age of the peat. From whatever cause, there was a time when the general surface of the country was bare and lifeless, which was followed by a growth of plants, in no way differing from those that are now struggling for existence upon the moor. And from what has been said before, it would seem that man made his advent here at much about the same geologic time.

A common tradition of the Lewis is, that the ground was once entirely covered with forest trees, and that the wood was burnt down by the Northmen to deprive the aborigines of the shelter that it afforded. In almost all traditions there is some relation to fact; but without going into the history of this opinion, it will be enough to notice, that as far as I am aware there is but one place in Lewis where the remains of forest trees are to be found. The roots of firs over twelve inches in diameter occur near Balaline, in the parish of Lochs, and only there. These roots are always on the clay soil, for neither bush nor tree is found with its roots in the peat.

But although in a thousand cases the section of a peat bank, from its surface to its base, exhibits only a succession of marsh plants, a patient observer will here and there find a spot where the foundation of the peat is a floor of twigs and leaves. This, as stated before, bears only a minute proportion to the moor peat of the country. When examined it appears to be made up in great part of the twigs of the birch, but I have no doubt that the berry and bush of the mountain ash, the larch, the aspen, and the willow could be detected. In fact, it so happens that in this strange country, where many of the manners of the tenth century still exist, the method by which this peat of scrub and brushwood was formed can still be seen. On the small islets in the lakes, to which neither sheep nor cattle can gain access, a dense mass of scrub still survives. The heather will grow four feet in height, and above that may be seen the red berries of the mountain ash, or, if in spring, the catkins of the willow, or the pendant leaves of the aspen, with briers and brambles to interlace the whole. In the face of some cliffs and banks, and even in a few remote spots, the holly, hazel, aspen, birch, and willow, still struggle against an adverse climate as they did a thousand years ago.

I have been thus particular in pointing out the limited quantity of wood peat, and where it occurs, its position, resting upon the boulder clay, for a purpose to be more particularly described at the close of this paper; and I pass on to notice some important geological changes that have taken place in the most recent or peat-forming era.

My official duties led me last summer over several hundred miles of the most tortuous coast-line imaginable. Between North and South Uist lies the large island of Benbecula, and about five hundred others of different sizes and shapes; most of these can be approached on foot at low water, and the rest are only separated by shallow channels. On going round the coast I began to notice that the peat banks formed frequently the sea-margin at high water; and feeling that it was a point of some geological importance, I noted the places on my sketch of the coast, till at last finding that the phenomenon was extremely common, occurring perhaps twenty times in a day's walk, it was no longer necessary to record its occurrence. After examining hundreds of examples, I came to the conclusion that, in these instances, there was no other way of accounting for peat banks having that position with regard to the sea-margin, than by the subsidence of the land. In many of the cases referred to the peat rests at once upon the naked gneiss. Now, the surface of the gneiss is as rugged as, and not very unlike what, the surface of the ocean would be if it were suddenly solidified in the middle of a violent storm. The peat has grown over the undulatory surface, but, as was to be expected, is deepest in the depressions, where I have sometimes seen it in section more than ten feet in height. Let it be supposed that the relative levels of land and sea remained the same until the formation of peat had occurred, and then that the land began to subside. The effect would be that when the sea reached the foot of the peat banks small cliffs would form, identical in their features with those of clay or gravel, or any other soft material. But from the extreme softness of the peat the sea would quickly eat it away, and work itself into all the sinuosities of the surface gneiss that were below the level of high water. This is what has happened around Benbecula; the sea at high water flowing in amongst the knolls, at first forming a simple gap, then branching out like the arms of a tree; at a further stage in the destruction of the peat, a group of islands is formed, till at last the whole vegetable soil is washed away, and a few bare rocks serve to point out where but one generation ago the cattle have pastured and corn has grown. Some of these rocks, which are now completely bare, still bear the names of particular plants that once grew upon them. It is difficult in words to convey an idea of the appearances and of the facts; but an inspection of the coast would show that the peat could only have been brought into its present position by the subsidence of the land. There are, indeed, but two other ways by which the peat can be found to form the sea-coast; one is by the action of the sea upon the shore, the other by the peat advancing to the sea by slip. But neither of these cases will apply to the sea threading in among the knolls and hillocks, eating out holes at first, which become pools, then lagunes, till at last the land that enclosed them is all gone. It must therefore be accepted as a fact, that the land has subsided (and is subsiding) since the peat began to form, and, consequently, that the stone circles of the Lewis are of an age anterior to that subsidence; it follows, then, that if the rate and quantity of subsidence was known, and supposing it to be uniform, we should arrive at the least age of the Pagan monuments.

Although we cannot arrive at the whole quantity, we have fortunately a measure of a part of that subsidence; this is afforded by what have foolishly been called submarine forests, but which are in fact submerged peat-banks.

In the Orkneys I have noted six places at which submarine peat is said to be found; at Otterswick, in Sanda, I have seen the people digging it at low water for fuel. The peat was mainly composed of twigs and leaves; and the seeds of the birch was plentifully scattered through it. There were also many gnarled pieces of wood, of the thickness of a man's arm. I was informed, on describing the kind of peat found at Otterswick, that the same sort of fuel may be got at Balranald, on the west of North Uist, at the level of low water. Peat also occurs below mud and gravel between tidemarks at the head of West Loch, Tarbert, in Harris; and Martin, the historian of the Hebrides, speaking of Pabbay, an island in the Sound of Harris, says, "The west end of this island, which looks to St Kilda, is called the Wooden Harbour, because the sands, at low water, discover several trees that have formerly grown there. Sir Norman Macleod told me that he had seen a tree cut there, which was afterwards made into a harrow." Several traditions could be added, of places now submerged that were formerly the sites of chapels or houses; and I think it may be taken as proved, that since the commencement of the peat-forming era, the land has sunk or subsided twelve feet at least; how much more, there are no means of finding out, for the submarine peat may have grown near to, or far away from, the high-water level; neither do we know how far the submerged peat-banks extend beyond the level of low water.

From the foregoing facts, it may be inferred that very soon after the climate of the Hebrides became such as to admit of the growth of vegetation, man emigrated to these shores, bringing with him the arts of agriculture and navigation, and a religion that induced him to honour the memory of his illustrious dead. Since then the tanned vegetable mould has accumulated to the height of at least five feet, and also since man's advent here the entire land has sunk twelve feet or more. These data may, by a more extended investigation, form a measure to the time of his arrival; at present I must content myself with having pointed out the facts.

On the Cervical and Occipital Vertebræ of Osseous Fishes.

By Charles Robertson, Demonstrator of Anatomy in the University of Oxford.*

In the present communication I propose giving a description of some peculiarities of the cervical vertebræ, and their appendages, in a few osseous fishes, which, as far as I know, have not before been described, but are of importance in considering the vertebral theory. I shall then proceed to show that the same kind of modifications are met with in the grouping of the elements of the occipital segment of fishes; so that in the skull, as in the vertebral column, the same elements are not invariably present, but are subject to variations.

In dissecting a tunny brought from Madeira by Dr Acland, I observed a very peculiar arrangement of the upper row of ribs† on the cervical portion of the vertebral column. When the upper row was cleaned out and traced forwards, the most anterior rib was found apparently articulated to the upper surface of the exoccipitals, and, as I had never met with ribs attached so far forward as the exoccipitals, I thought that this being an old specimen, the first cervical rib had anchylosed to the posterior extremity of the exoccipitals, and so formed this very peculiar arrangement of parts.

Since that time, by the kindness of Dr Acland and the Dean of Christ Church, three heads were procured from Madeira and forwarded to the Museum at Christ Church, and various sections have been made to illustrate the points noticed in the present communication. On examining a vertical section of the cranium (fig. 1), the basioccipital, 1, is seen to be entirely overlapped by the prolongation backwards of the sphenoid, 4 4. At the posterior extremity of the basioccipital, 1, a small cavity

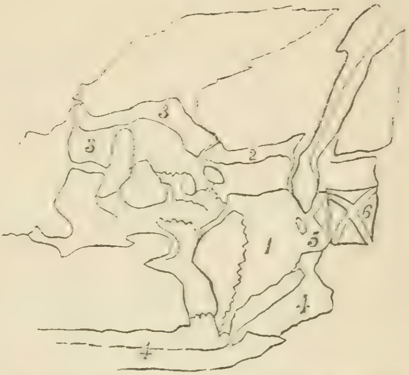
---

* Read at the Meeting of the British Association at Manchester, 1861.

† By upper row of ribs, I mean those elements called by Professor Owen appendages, which are generally in the centre of the trunk attached to the lower ribs, and when followed anteriorly and posteriorly, generally terminate on the centra or neural arches of the vertebræ.

is seen in the occipital, with a thin lamina of bone behind, 5, which forms the cup between this and the next centrum, 6. On the upper surface of this lamina of bone there is a considerable cavity, which has freely lying in it the neural arch of the first vertebra, which is much smaller than any of those succeeding. The basioccipital, 1, has resting on its upper surface, a pair of bones, 2 (exoccipitals), which form a canal of considerable length, and to the external surface of this canal the first pair of the upper row of ribs is attached. From an examination of four skulls differing much in size and age, I have not found any trace of suture between the posterior portion carrying the first pair of ribs and the more expanded anterior portion; and if such a suture did not exist at an early period of development, these ribs must belong to the occipital segment; for, as I shall show presently, all the vertebræ posterior to this have each their proper ribs articulated to them, and therefore are not displaced elements. As the exoccipitals do not form a part of the cranial walls, but the anterior part of the canal for the cord, they are not in this case cranial bones,—other elements, as I shall show farther on, having taken their place.

Fig. 1.



A vertical section of the posterior part of the cranium and two first vertebræ of a Tunny.

1. Basioccipital. 2. Exoccipital. 3. Supraoccipital. 4. Sphenoid. 5. First rudimentary cervical. 6. Second cervical.

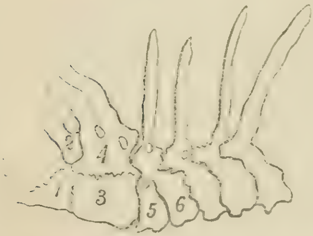
In the tunny, the number of vertebræ, including the first rudimentary, is thirty-nine. The upper row of ribs begins anteriorly on the exoccipitals, and the first and second vertebræ have each a single rib attached to the neurapophyses. At the fourth vertebra, the first of the lower row of ribs is found articulating with the centrum, and the upper rib resting on its head. The same arrangement is continued to the fifth.

sixth, and seventh. At the eighth, the upper row of ribs leaves the lower, and continues attached to the lateral portions of the centrum, till the twenty-ninth, which is the last. The sixth is the strongest and longest, and from it they gradually decrease in size to the last. The lower row is attached to the parapophyses, or the spines formed by their union from the eighth to the eighteenth. The eighth is the broadest and longest, and from it they gradually decrease till the last.

In the pike and eel, two rows are also present; but in them the upper and lower rows never come in contact. The upper row continues attached to the neurapophyses; the lower to the parapophyses. In the bream, the two first vertebræ have ribs attached to long transverse processes. At the third vertebra, the first of the lower row makes its appearance with the upper, articulating to its head. This arrangement is continued till the eighth, when the upper row gradually advances upwards, and continues to be attached to the parapophyses, and the last to the centrum.

An Indian fish (*Synanceia horrida*) presents a very striking instance of the way in which the trunk vertebræ become modified by displacement. The sphenoid does not overlap the basioccipital, 1 (fig. 2), to any great extent, and the under surface of the cranium presents a smooth, unbroken surface, without elevation or depression. The centrum of the first cervical vertebra, 3, is about three times the length of the second, 5. It carries, besides its own neurapophyses, the neurapophyses of the second, which have become anchylosed together, 4. Each of these anchylosed neurapophyses carries a pair of free ribs, as in the tunny, and the neural spines are wanting. Each neurapophysis is perforated in the centre by a foramen for the spinal nerves. The centrum of the second, 5, does not carry any

Fig. 2.



Posterior portion of the cranium and the first six vertebræ of an Indian fish (*Synanceia horrida ?*)

1. Basioccipital. 2. Exoccipital. 3. Centrum of the first vertebra. 4. Neural arches of the first and second vertebræ. 5. Centrum of the second vertebra. 6. Centrum of the third vertebra.

neurapophyses, owing to the prolongation forward of the neurapophyses of the third vertebra, 6, which has come in contact with the second, 5, and by that means pushed up its neural arch, which has fused with that of the first. The first four ribs are attached to the neurapophyses of their proper vertebra ; those of the fifth, sixth, and seventh are attached to the centrums. Parapophyses are distinctly developed on the eighth, bending down to form the commencement of the hæmal canal. Ribs are attached to the parapophyses, from the eighth to the eleventh. The ninth carries an additional stunted rib. It will be observed in this case, that it is only on the ninth that two pairs of ribs are met with.

In the pike, the first cervical vertebra carries a neural arch, the upper portions just meeting, but not sufficiently to form a spine. A short and broad rib is anchylosed to each neurapophysis. In front of the first vertebra, covering the foramen magnum, is found, resting on the exoccipital, the neurapophyses of a vertebra without a centrum. In an old pike I found all traces of suture between this first vertebra and the exoccipitals had disappeared, and presented a long canal, prolonged back from them as in the tunny. In the carps, if the bar of bone bounding the posterior extremity of the exoccipitals, and forming the posterior boundary of the very large foramen for the first pair of spinal nerves, which supply the pectoral fins, be traced from above downwards, distinct traces of suture are seen between it and the exoccipitals on which it rests, and on following it upwards, another suture is found dividing it from the supraoccipitals ; so that the bars do not meet above to form a complete arch, the supraoccipitals being prolonged back between these two plates, and forming the upper portion of the arch. In the greater number of Cyprinoid skulls this suture was more or less distinct, depending on the age and size of the specimen and species. There can therefore be no doubt but that this bar is the neurapophysis of a vertebra without any centrum of its own, but resting on the basioccipital, and in a much more rudimentary state than that of the pike.* The exoccipitals of the carp are not perforated by unusually large foramina, as usually described, but by one only for the eighth pair of nerves.

---

* Lord Scarborough very kindly sent to the University Museum some very

On the Occipital Segment of Osseous Fishes.

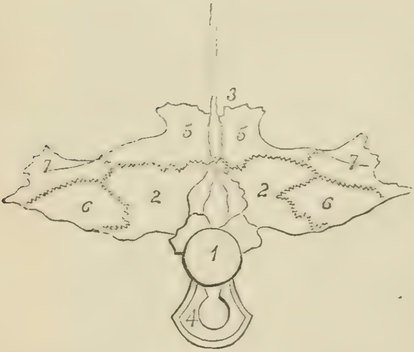
In the examination of the skulls of fishes, it should be borne in mind that the bones forming the upper and posterior portions of the crania exist, in the first place, for the purpose of protecting certain ganglia; and secondly, certain spinous processes are given off from them which serve for the attachment of muscles. Such bones existing for the protection of certain ganglia, and the size of these ganglia depending on the habits of the fish, I have found it convenient to divide them into two great classes—

I. Those active, with a large cerebellum.

II. Those sluggish, with a small cerebellum.

I hope to be able to show that, in the active, certain bones are always found, owing to the large size of the cerebellum, but which are not present in the sluggish. As an example of the first division I shall describe the occipital segment of the Tunny, in which the cerebellum is largely developed, and that of the Lophius as an example of the second, where the cerebellum is rudimentary.

Fig. 3.



Cranium of a Tunny, viewed from behind.
1. Centrum of the first rudimentary cervical.
2. Exoccipitals.
3. Supraoccipitals.
4. Sphenoid.
5. Epiotic (Huxley), paroccipital (Owen).
6. Detached petrosal (Owen), "rocher" (Cuvier).
7. Mastoid.

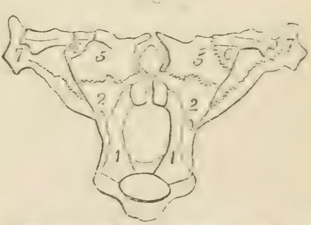
In the tunny the exoccipitals, 2 2 (fig. 3), cover the whole of the upper surface of the basioccipital, 1; they meet above in the median line, but are not anchylosed, and expand out laterally, to articulate with the mastoid and petrosal of Professor Owen. On

fine carp, which have been of great value in illustrating the osteology of the Cyprinoids.

examining a vertical section, they do not form any part of the cranial walls, but are merely wedged in behind the bones forming the cranial cavity. Resting on the upper surface of the exoccipitals are two bones (parapophyses of Owen),* much larger than the exoccipitals. They meet in the median line, form a large portion of the cranial walls, articulating externally with the mastoid, 7 7, and postfrontals, and in front with the parietals, which have the supraoccipital, 3, prolonged forward between them. Completing the arch above, we have the supraoccipital, 3, which forms but a small portion of the cranial walls, and has a considerable spine prolonged backwards from its central part. It rests on the anterior surface of the epiotics, 5 5, articulating laterally with the parietals, and in front with the frontal. A slender process is sent backwards between the epiotics, 5 5, so as slightly to divide them externally, but it does not prevent their meeting on the internal surface. In some skulls this process from the supraoccipital is wanting. The petrosal, 6 6, of Professor Owen is a bone of considerable size, wedged between the mastoid and the exoccipitals, and receives the lower prong of the suprascapula.

On the upper surface of the exoccipitals, 2 2 (fig. 4), of the Lophius rest two bones† of nearly the same shape as those of the tunny. They meet above, form a large portion of the cranial cavity, and send out processes to articulate with the parapophyses of Owen, 5 5, and mastoids, 7 7. On their anterior and upper surfaces they articulate with the parietals, which meet in the median line. A small foramen is observed between the posterior and inner surfaces of the parietal and these two bones. The connections of these two bones in the Lophius

Fig. 4.



Cranium of a Lophius, viewed from behind.
1. First cervical vertebra.
2. Exoccipitals.
5. Epiotic.
6. Homologous, with so-called detached petrosal of the tunny (6).
7. Mastoid.

---

* These bones have received the name of Epiotic, from Professor Huxley. (Proceedings of the Royal Society, November 18, 1858.)

† Divided spine of Professor Owen.

are nearly the same as the epiotics in the tunny. In both cases they meet in the median line, and form a large portion of the cranial cavity. I think, therefore, from their connections, that the epiotics of the tunny are homologous with the pair of bones forming the upper portion of the occipital segment in the Lophius—the only difference between the two being, that in the tunny the suprascapula has two prongs, the upper of which articulates with a strong process sent outwards from the epiotic; in the Lophius, the lower head of the suprascapula only is present, so there is no process sent out from it. From the connection of these bones in the Lophius, and their forming part of the cranial walls, I do not see how they can be called divided spines, but a second pair of neurapophyses carried above and in front of the lower pair, forming more or less of the cranial walls, according to the size of the cerebellum, the sides of which they have to protect. It may be asked, if the upper pair of bones of the Lophius are neurapophyses, where is the neural spine? I have come to the conclusion, after a careful comparison with the tunny, that in the Lophius it is wanting, owing, as I suppose, to the cerebellum being quite rudimentary in that fish. The space left between the parietals and the upper pair of bones affords strong grounds for believing that it is absent. From a comparison of the skulls of various fishes, and keeping the cerebellum strictly in view, I think it will be found that the neural spine is only present in those active species which have a large cerebellum to protect, and that it is always single, and never divided. One great objection to the vertebral theory is the presence of single spines in the trunk vertebræ, and double spines in the cranial segments. I have not been able to find among the authorities on this subject any instance in which the neural spines of the trunk vertebræ are ever double, as they are supposed to be in the cranium, and I think it will be found that the spine is wanting in such sluggish fishes as the Lophius, Lepidosteus, &c. The skull of a Lophius and tunny, which I have before me, are both the same length—nine inches. The occipital segment of the tunny, measuring from the anterior extremity of the supraoccipital to the first vertebra, four and a half inches. In the Lophius the same parts are only two inches. The very great extent of the occipital segment in the tunny, no doubt, stands in relation to the large cerebellum which it has to protect. I have not been able to examine accurately the extent of the cerebellum in the tunny, but that of the mackerel will answer the same purpose, the two are so closely allied. The cerebellum sends forwards a thin, tongue-shaped process, which rests on the posterior surface of the cerebral hemispheres, pushing the optic lobes out laterally, as in birds. In order to cover this tongue-shaped mass, the supraoccipital has to be carried forward with it, pushing the parietals out laterally, which are small, and just sufficient to cover the optic lobes.

From an examination and comparison of the bone called petrosal by Professor Owen, and "rocher" by Cuvier, in the carp, perch, turbot, and cod, with that called parapophysis in the Lophius, I have come to the conclusion that the supposed parapophysis of the Lophius is homologous with them. It seems to me that great confusion exists with regard to the attachment of the suprascapula, whereas nothing is more simple. When the lower prong only is present, it articulates with a bone between the exoccipitals and mastoid; and when the upper is present, it articulates with the epiotic. This so-called petrosal may be wedged between the exoccipitals and mastoid, as in the tunny, or it may be applied on the upper surface of these bones; but it always retains its relation to them; and where the scapula is attached to the cranium, it is always present as a distinct bone. From the constancy of this bone, and its receiving the lower prong of the suprascapula, which bears a great resemblance to a rib with its head and tubercle, —this bone, therefore, always receiving the head of the rib, is homologous with the parapophyses in the column, and not a bone peculiar to certain species. When the upper prong of the suprascapula is present, it articulates with a process (diapophysis) sent out from the upper pair of neurapophyses, the epiotics. In support of this view, it may be stated that the parapophyses of the trunk vertebræ are often developed from separate centra. The diapophyses cannot be said to exist in the trunk, as there are no tubercles to the ribs. Even where they do exist, they are always exogenous, never autogenous.

It is not my intention, on the present occasion, to follow the bones composing the upper portion of the cranium any farther forward. Many more examples might have been adduced in support of the views presented in this communication; but I have thought it better to take a few common examples, which are within the reach of any one who may wish to investigate the subject for himself. A consideration of the preceding facts will show, that in osseous as in cartilaginous fishes, more particularly at the anterior end of the column, vertebral centra are often met with, carrying two pairs of neurapophyses; and as no displacement has taken place, it cannot be said that each vertebra should consist of one pair of neurapophyses only. As I have shown in the tunny, one of the highest of fishes, the exoccipitals do not take any part in the formation of the cranial walls, but rest on the basioccipitals, to form the anterior portion of the canal for the cord. The epiotics, in this case, form a large portion of the cranial walls, and, in fact, take the place of the exoccipitals, which in this case, and in many others, are not cranial bones at all. So that the occipital segment is not always made up of the same elements, and it is uncertain where the column ends, and where the cranium proper begins. As a termination of this paper, I have drawn up a brief summary of the conclusions I have come to regarding the occipital segment of fishes.

1. The posterior walls of the cranial cavity protecting the cerebellum are not invariably formed by two pairs of neurapophyses, exoccipitals and epiotics. When the exoccipitals take a large share in the formation of the cranial walls, the epiotics are excluded; and when the epiotics are large, and admitted into the cranial walls, the exoccipitals are excluded.

2. The neural spine is only present in the active species which have a large cerebellum to protect, and it is never divided.

3. The petrosal of Professor Owen is found in all species having the pectoral fin attached to the occipital segment, and always receives the lower prong of the suprascapula.

On certain Species of Permian Shells said to occur in Carboniferous Rocks. By Professor WILLIAM KING (Queen's College, Galway), Queen's University in Ireland. (Continued from vol. xiv. p. 45.)

The plan of including in a species two or more groups of forms, each having definite characters, is, in my opinion, disadvantageous in three respects. It involves a cumbrous nomenclature ; it is wanting in geologico-chronological precision ; and it does not convey to the student any idea of certain persistent characters. Is not "*Spirifera Urei, var. Clannyana*," a cumbrous name ? Does the name *Spirifera Urei* convey the idea that the particular age of the shell we may be referring to is Permian ? And, noticing for the moment a generic consideration, does the name *Spirifera*, which is frequently given to the Permian species in question, express that the shell belongs to a group of *Spiriferidæ*, which is generally without ribs, of an oval or circular form, and furnished with a small area ? But by calling the shell *Martinia Clannyana*, we at once get rid of a cumbrous name ; we know that it lived in the Permian period ; and we have its general outline before us.

Further, the plan is too dogmatic, and altogether unsuggestive of any philosophical conclusions. Admitting, for the sake of illustration, that the Lamarckian or Darwinian doctrine is incorrect, the plan impliedly denies to Creative Power the ability to produce two species, between which it may be difficult to draw the line of demarcation ; or in other words, it will not allow of osculant species having been created independently of each other. No—they must be mere varieties, which have been developed by the intervention of extraneous causes. But this is not all. Nearly every recent British species of *Litorina* and *Mactra*, if occurring as fossils in palæozoic rocks, would have had their independent creation ignored, and have been respectively named *Litorina variabilis*, and *Mactra multiformis !* The plan of itself can only lend a feeble assistance to the palæontologist in enabling him to determine specific affinities, or to take his part in working out the relative order of creation, in Time, of the various organic types which have successively appeared on the earth's surface. It would, in short, make him little more than a mere species-maker! It would be of no interest that *Martinia Clannyana* lived only during the Permian period; or that under the name of *Spirifera Urei* it existed as a Permian, Carboniferous, and Devonian species;—or whether the *genus* to which it belongs flourished in several, or only in a few, of the great chronological terms recognised by geologists; or whether *it* culminated in this or in that period.

In determining fossil species, there are certain considerations to be observed of especial importance. If a group of shells—doubtful as to whether it includes more than one species—belonging to only one system of rocks, assumes a variety of forms, constituting sub-groups, none of which can be distinctively defined, such a group may be practically considered to represent a single species, though there may be a possibility of its containing more than one. We have an illustrative case in *Productus horridus*, a species occurring under several so-called varietal forms, some of which may really be species; but they graduate so imperceptibly into each other that hitherto it has been found impossible to characterise any one of them separately. They are consequently marshalled together as one species by all who have described them. *Dielasma elongata* is another case in point. Possibly some of the species quoted in my "Monograph" are too closely connected with those from which they have been separated to warrant the position they hold in that work; but I cannot admit the same in respect to others. *Dielasma sufflata*, for example, is by form alone distinguished from *D. elongata*, with which it has been confounded; but its individuality, as a species, is further supported by characters which are maintained over a wide geographical area. Another consideration is of equal importance. In *Martinia Clannyana*, we have not only a set of good differentials by which to separate it from *M. Urei;* but non-contemporaneity, besides, of these two species, completes, in my opinion, their distinctiveness. This last consideration causes me to pronounce less decidedly than Mr Davidson as to the Permian *Spiriferina cristata* being specifically identical with the Carboniferous *Sp. octoplicata*.

Definable distinctive characters, if persistent over a wide geographical area, and restricted to a single geological period, are safe elements in the determination of fossil species. But what other elements might we not have had if such were now living, considering that many existing species of mollusca are, in a great measure, determined by habit, habitat, colour of shell or animal, epidermis, opalescency, and other characters, which it is impossible for a palæontologist to become acquainted with.

The study of existing shells also teaches us that many species have a tendency to simulate the principal distinctive character of others allied to them. Occasionally *Fusus Islandicus* appears with its mammillated apex, resembling the finely-whorled one of *F. propinquis; Buccinum undatum* throws off its undulated ribs, and approaches, in smoothness, to *B. Humphreysianum; Mya Uddevallensis* loses its posterior obliquity, and becomes squarely truncated, like *M. truncata; Astarte Danmoniensis* divests itself of marginal crenulations, and approaches to *A. Scotica;*[*] *Solen siliqua* curves its valves in imitation of *S. ensis;* and *Lutraria elliptica* loses its marked dorsal convexity, and thus approaches to *L. oblonga.* These twelve species, and some more allied to them, would undoubtedly have been reduced to half their number had they occurred as palæozoic fossils. Other examples of the kind might be cited; but these, I think, are sufficient to show that simulating forms may also occur in a fossil state.[†]

The references that have been made to recent shells are of a nature to teach palæontologists extreme caution in pronouncing that such and such groups are *not species*, but mere varieties.

On the Origin of Species, &c. By Professor William King (Queen's College, Galway), Queen's University in Ireland.

It would be an insult to reason to deny the power of the Omnipotent to create at once plants and animals out of inorganic or any other kind of matter: on the other hand, it would be equally irrational to doubt His power to ordain and sustain laws by which *originally created* organisms could be adapted to, and modified by, external influences. The two modes may be designated, the first, Autotheogeny;* and the second, Genetheonomy.

---

[*] I am quite aware that Forbes "excited some little surprise" among naturalists, by uniting as one the two Astartes named in the text.

[†] I am somewhat more inclined to regard the "Bolland shell," noticed in a previous page, as a variety of *Dielasma sacculus*, and simulating *D. sufflata*, than as belonging to the last species.

Until within the last few years, Genetheonomy was far from sufficiently supported by the arguments of its advocates; those advanced by Lamarck, Geoffroy St Hilaire, and the author of the "Vestiges," being only of partial application, or simply illustrated by a restricted group of analogies.† It remained, however, for Darwin and Wallace to enlarge the field of well-sustained argument supportive of creation by Divine law.

But, does the hypothesis of the last named naturalists sufficiently explain the various genetheonomous phenomena? My own reasoning compels me to answer in the negative. I admit the *immediate* efficiency of "Natural Selection" in producing a species; but I cannot divest myself of the impression that it only holds the rank of a subordinate or ancillary agent. The particular view under consideration, if I am not much mistaken, implies that plants and animals are modifiable by mere external influences—of course, acting by law. Entertaining this opinion, I am led to regard "natural selection," as widely removed from the direct action of primary laws; and functionally no higher than chance or accident, as conceived by the untutored.

---

* I hold that an organism, whether it typifies a species, a genus, a family, an order, or a class, is an autotheogen, if it possesses any character which isolates it from other equivalent groups: on the other hand, any such groups, through being acted on by inherent or external forces, I am disposed to believe have become more or less modified, thereby giving rise to genetheonomous forms. I do not see why Mr Darwin should not admit the same, notwithstanding his present belief merely recognises among animals "at most only four or five" autotheogenous roots of as many classes. On psychological grounds alone, man must be regarded as isolated from all other organisms; hence I consider him to be an autotheogenous species.

† If organisms underwent changes *only during their embryonic stage*, the author of the "Vestiges" would have some grounds for his theory of development "by generation"—by "a universal gestation of nature, analogous to that of the individual being;" but, considering that all organisms undergo, *after their birth, and throughout the entire period of their existence*, successive modifications (less marked, it is true, in the higher Vertebrata than in the Invertebrata and Batrachia), it is manifest that the doctrine of the "Vestiges" has nothing in its favour except a restricted group of analogical phenomena. Its author has made out a case of "parity of plan between embryonic development and the succession of life on our planet;" but he has failed, as far as I can understand the theory, in establishing "a real identity of character in the two sets of phenomena."

I feel a difficulty in understanding how "natural selection" could produce a species, unless other and higher principles were involved. Every individual plant and animal is confessedly acted on by forces, the nature of which has never yet been revealed by science. Some conception may be formed of one, paramount in my mind, by designating it "progressive change." A principle of this kind appears to me to be inherent in animated nature; or how can we otherwise explain the "unity of plan" pervading both organic kingdoms, the "phenomena of parthenogenesis," the "advance and progress in the main"* which our life system has undergone in past geological ages?

The supremacy of progressive change may be exemplified by referring to the successive modifications which the human organism passes through in its progress towards maturity; while the ancillary or subordinate character of natural selection is well illustrated by the changes which external agencies have effected on the same organism, producing, as admitted by nearly all, the leading varieties of the genus *Homo.*†

---

* There is no difficulty in citing instances which cannot be reconciled with "an advance and a progress in the main;" but these are obviously exceptional. I cannot agree with Mr Darwin in his view of the "geological record"—of its being so "imperfect" as he seems to think. Many important connecting links, binding in close union all the members of our life system, are undoubtedly wanting; but, in taking a general survey of the facts revealed by palæontology, commencing with the marine fauna of the Taconic period, and closing with that now in existence, it is to me a matter of surprise, considering how limited is the field of observation, that the "geological record" is so perfect. There is apparently some difficulty in accounting for the occurrence of so many invertebrate orders—low as well as high—in Taconic rocks; but we must not overlook the fact that many of these groups *now* include forms of the simplest type, *doubtful even as to their ordinal rank;* nor must we overlook the probability of the Taconic trilobites, annelids, cephalopods, palliobranchs, corals, &c., being more closely related to each other than is the case with their representatives of later geological periods.

† With respect to the varieties of man, I hold that they are genetheonomous

I am disposed to regard, then, progressive change as one of the great primary modifying principles of organic nature; and "natural selection" as a secondary one,—the latter immediately operating in the production of *proximately-allied* specific and varietal forms.

Some years ago I contributed a few facts, which showed that variations of physical conditions, as depth of water and nature of sea-bottom, induced in certain British shells modifications of form equal to differences prevailing between many species of mollusca:[*] in a paper published a year or two previously, I particularly noticed the remarkable, and, in many cases, imperceptible gradations of generic characters running through the tetrabranchiate Cephalopods:[†] and in my "Monograph," I have pointed out the various forms assumed by *Camarophoria Schlotheimi*, and some other Permian fossils. These may be taken as evidences that I have not been inattentive to the vexed question of species. Of course, it would ill become any one to dogmatise on the question, and disbelieve in the future turning-up of facts subversive of his preconceived notions; nevertheless, I feel myself bound to declare, that all my observations and reasoning incline me to believe in the two modes of creation herein advanced.

---

degradations of the Indo-Caucasian type, developed by the physical conditions peculiar to the regions they respectively inhabit. Cogent reasons may be advanced for regarding the American Indian as having descended from the Mongolian, and the latter from the Indo-Caucasian. Even the aboriginals of Australia may be looked upon as another degraded race. Those inhabiting the south and west coasts are confessedly inferior to other oceanic tribes, as they appear to be incapable of constructing canoes. From some remarks recently made by Professor Jukes, one might be led to attribute this mark of inferiority to the apparent absence in Australia of indigenous timber suitable for canoes (*vide* "Athenæum," No. 1793). I believe, however, a more general cause has operated; one involving physical conditions. Nevertheless, I certainly prefer accepting the particular circumstance stated, as one of the means which have brought about the degradation of the Australian, to adopting the view which considers him to be a distant "blood-relation" of some extinct ape, even should the remains of species be found hereafter more human-like and more manipulative than the gorilla or chimpanzee.

[*] See Annals and Magazine of Natural History, vols. xviii. and xix.

[†] See Ibid., vol. xiv.

Notice of the "Angwántibo" *of Old Calabar, Africa; an Animal belonging to the* FAMILY LEMURINA; *and apparently a new species of the Genus* Perodicticus, *of Bennett.*

By JOHN ALEXANDER SMITH, M.D.* (Plate III.)

The interesting little animal (now exhibited) was given to me by Mr William Oliphant, who received it some time ago from the Rev. Alexander Robb, one of the U. P. missionaries at Old Calabar. The following extract from a letter, dated Old Calabar, 1st December 1859, gives some details concerning it:—"I was at Creek Town yesterday, and received from 'King Eyo Honesty' a small bush animal; or, as the Krumen call it, 'bush meat,' which I brought with me to give to Mr Thomson, who is with us for a day or two, as he takes a great interest in these matters. He, however, advised me to bottle the animal, and send it to you myself; which, therefore, I now do with pleasure. We have put it up so that it ought to reach you in safety. It is in a stoppered bottle, well sealed, and the bottle is put up in a small tin box wrapped up in our native grass cloth. It seems to be a *lori*, or *Stenops tardigradus*. The Calabar people call it *Angwántibo* (*Angwán* means a farm), but we do not know the etymology of the second part of the word, and cannot say whether it arose from any habit peculiar to the animal. It lives in trees; but, being nocturnal, the people know exceedingly little about it. They cannot tell what it eats. A lad whom I asked said that *he* lived in the house, and *it* lived in the bush; how, then, could he know anything about it? My Krumen also recognised it as a countryman of theirs. They consider the one sent as a young one; and say that in their country it grows to the size of a common puss. Probably theirs is a different animal, but I cannot tell. They call it *Dwăn*, and say that it lays down the law to the other beasts, forbidding them to eat the young *fruit* when it begins to form on the trees. If the monkey transgress, the *Dwăn* seizes him, and holds him there till he dies,—yea, the monkey rots in his grasp. They say that they are shot together thus. If the monkey gets the shot, the *Dwăn* holds on; if the *Dwăn* gets the shot, they fall together. The Krumen say that the *Dwăn* eats fruit. This is all we know about it at present; and their (the Krumen's) account seems somewhat fabulous. One of the legs of this specimen is broken. I will send it by the mail that takes this to your address.—I am, &c., ALEXANDER ROBB.

---

* Read before the Royal Physical Society, Edinburgh, 25th April, 1859.

"*P.S.*—Since writing the above, I have met a youth who professes to know about the *Angwántibo.* He says it sleeps by day, and eats at night; and that, when full grown, it is as big as an *old cat*, and that it eats fruit."

In a subsequent letter from Mr Robb, dated 28th February, 1860, he says:—"I trust you received the *Tardigradus* sent a few months ago. Another specimen which I procured I handed to Mr Thomson, who, I believe, sent it to Mr Murray."

I have also received from the Rev. H. M. Waddell the following notice, which he had put down in his note-book as descriptive of the "*Angwántibo:*—An animal of the sloth kind, lives in trees, hangs on the branches, and eats fruit. Rather larger, when full grown, than a large cat. Longish snout, short ears, each foot three long crooked toes and claws, with a thumb similarly shaped. No tail. Dun colour; cannot walk on the ground. When set down, crawls a little, falls over, and rolls itself up in a ball. Inoffensive."

The animal belongs to the FAMILY of the Lemurs, LEMURINA s. PROSIMII, and to the first division of the family which is distinguished by Van der Hoeven in his valuable "Handbook of Zoology" (translated by the Rev. W. Clark, M.D., London, 1858), as follows:—

PHALANX 1. *Nail of the Index alone of the soles incurved, subulate. Upper incisor teeth four, in pairs.*

A. *With tarsus not elongate.*

Under this great subdivision, it belongs to the

Genus STENOPS, Illig. (genera *Loris* and *Nycticebus*, Geoff.)

Incisor teeth $\frac{4}{4}$, *canines* $\frac{1-1}{1-1}$, *molars* $\frac{6-6}{6-6}$. *Ears short, rounded. Eyes large, approximate. Index of hand short, not longer than pollex. Tail short, or none.*

Van der Hoeven subdivides the Genus *Stenops* into the three following sections:—

(*a*) *Tail short. Index of hand very short, resembling an unarmed tubercle.* (*Perodicticus*, Bennett.)

(Sp.) *Stenops potto, Lemur potto*, Gm., *Nycticebus potto*, Geoffr., *Perodicticus Geoffroyi*, Benn. Gold Coast of Guinea. *Potto*, Bosman.

(*b*) *Tail very short* (*Nycticebus*, Geoffr).

(Sp.) *Stenops tardigradus*, Auct., *Lemur tardigradus*, L. Bengal, Siam, Sumatra, Borneo. *Stenops javanicus*, nob., *Nycticebus javanicus*, Geoffr.

(*c*) *Tail, none* (*Loris*, Geoffr. Body slender; eyes very large, almost contiguous. Nose acute, sub-ascending).

(Sp.) *Stenops gracilis, Loris gracilis*, Geoffr., *Lemur tardigradus*, L. Ceylon.

The *Angwántibo* belongs apparently to the first of these subdivisions (*a*); although, with reference to the first character of this subdivision—that taken from the length of the tail—it agrees better with, and would therefore seem more naturally to come under, the second subdivision (*b*), still, the distinguishing and peculiar characteristic of the subdivision (*a*) seems to be the undeveloped index finger, and with this my specimen exactly corresponds. The length of the tail would appear, therefore, to be rather doubtful as a distinctive character; at least, this animal seems to be somewhat intermediate in its characters between the first two subdivisions of the genus *Stenops* as given by Van der Hoeven, viz.—(*a*) *Tail short; index of hand very short, resembling an unarmed tubercle;* and—(*b*) *Tail very short.* The *Angwántibo* having the *index of hand very short, resembling an unarmed tubercle;* and also, the *tail very short.* To include it, therefore, the first character of section (*a*) would require to be altered to—*tail short, or very short; index of hand very short*, &c. It seems to me, indeed, from the discovery of this *Angwántibo* (assuming it to be a new species), that the greater or less length of the tail is not sufficiently distinctive to allow any characters taken simply from it, to be used for the division into *sections* of the comprehensive genus *Stenops* of Van der Hoeven.

The generic character which Van der Hoeven gives of the GENUS *Stenops—index of hand short, not longer than pollex*, in the sections (*b*) and (*c*), or the equivalent GENERA *Nycticebus*, Geoff., and *Loris*, Geoff.—from the examination I have been able to make of these animals, appears to be due *to the smaller relative size of the metacarpal bone, and the phalanges of the index finger, which are* THREE *in number, as in all the other fingers* (*except the thumb*). In the *Potto*, however, and this *Angwántibo* (as will be afterwards described), which fall under his section (*a*), and the GENUS *Perodicticus*, Benn, the character of *index of hand very short, resembling an unarmed tubercle*, is due, not only *to the small relative size of the bones of that finger, but also to the presence of only* TWO *very small phalanges* (*the same number as in the thumb*), *the other fingers having three.* This anatomical difference forms a good distinction or character between section (*a*), the Genus *Perodicticus*, Benn., and the other Genera, which Van der Hoeven has also included in his great Genus *Stenops.*

The only species noticed by Van der Hoeven under section (*a*) of his genus *Stenops*, and, as far as I am aware, the only one known, is the *Stenops potto* or *Perodicticus Geoffroyi* of Bennett, and it, like this *Angwántibo*, is a native of Africa; the other described Genera, or species of Van der Hoeven's Genus *Stenops*, are inhabitants of Asia, the East Indies, &c. Van der Hoeven, in his description of this species, the *Stenops potto* or *Aposou*, says—"The *Aposo* or *Aposou* of the negroes of the Gold Coast of Guinea is a nocturnal animal, which sleeps on trees and lives on fruits. The spinous processes of the last five cervical and of the first two dorsal vertebræ are long, and pierce through the hairy integument of the back, with a weak, horny covering. Professor Halbertsma first drew my attention to this peculiarity, which I have observed in two specimens."

On referring to the description of this same species (the *Potto*), placed under the Genus *Perodicticus*, and named *P. Geoffroyi*, by Mr E. T. Bennett, which is published in the "Proceedings of the Committee of Science of the Zoological Society of London," for 26th July 1831 (Part I., 1830–31). I find the animal now exhibited agrees with the general characters given there of the Genus (correcting the mistake of considering the projecting teeth in the front of the lower jaw as being all incisors, instead of both incisors and canines, according to the present view; and therefore the incisors only four in number, and not six, as Mr Bennett described them). To which I would add, as additional characters of the GENUS *Perodicticus*—tail short, or *very short;* index of hand very short, resembling an unarmed tubercle—*supported by small metacarpal bone, and only* TWO *small phalanges.* The *Angwántibo* seems to differ, however, from the details given of the species which he describes,—the measurements of the *Potto*, or *P. Geoffroyi*, given by Bennett, being, "length of head 2 inches and $\frac{2}{10}$ths; of the body 6 inches; of the tail 1 inch $\frac{6}{10}$ths, or, including the hair, 2 inches $\frac{3}{10}$ths;" whereas, in my specimen, the whole length, from point of muzzle to extremity of tail, is about $10\frac{1}{2}$ inches; the tail being only $\frac{1}{4}$ of an inch in length, or, including the hair, which is about $\frac{1}{4}$ of an inch long, only $\frac{1}{2}$ an inch. The animal described by Bennett was immature, its dentition not being perfect; in the one now exhibited, the dentition is perfect. There seems to be other slight differences between the *Potto* and the *Angwántibo*, in the colour of the hair as well as in the relative size or proportions of the body and limbs, which I shall afterwards notice in describing this specimen; and, while at present unable to procure various works for reference, or a specimen of the *Potto* itself for examination (and therefore in want of more information on the subject), I am inclined to consider this specimen of the *Angwántibo* as being a mature individual, and probably forming another species of the same genus, and one, that so far as I am aware, has not before been described, I therefore, from the locality where it was found, give it provisionally the name of the *Stenops*, or *Perodicticus Calabarensis*.

The *Potto*, or *Perodicticus Geoffroyi*, is found at Sierra Leone, a region of the African coast, at some distance from Old Calabar. It is also known by a different name, being the *Aposo* or *Aposou* of the Gold Coast. The letters of the missionaries (from which extracts were given at the commencement of this communication) seem to indicate the possible existence of more than one species, probably of allied animals—the *Dwăn* of the Krumen, and this, the smaller *Angwántibo* of the natives of Old Calabar. Whether the *Dwăn* and the *Aposou* are the same, or different species, I am unable to determine: they probably bear a considerable resemblance to one another. From the great variety in size of the animals referred to in these letters, I am at present inclined to believe there may be two, if not three, distinct species,—the *Aposou*, the *Dwăn*, and the *Angwántibo*,—the *Dwăn* being perhaps the largest in size.

Description of the ANGWANTIBO (from specimen in spirits:)—

Perodicticus Calabarensis (Mihi)—*above, yellowish-brown; the roots of hair dark gray; below, paler, in some parts nearly white; hair wool-like; length from muzzle to point of tail,* 10½ *inches; tail very short,* (*about* ¼*th of an inch in length*).

Proximal phalanges of both hands and feet (not including the pollex) united together by the integuments; the two distal phalanges being free.*

The *Angwántibo* is covered with a thick and long wool-like hair, which becomes short and thin on the face and on the extremities, the inner sides of the fore and hind hands being free from hair. The hair is of a dark gray colour at the base, and the upper third or so of its length is of a light brown or fawn colour, the terminal points being of a darker brown; this is the general character of the fur of the upper parts of the body and limbs. The face in front of the eyes is rather darker in colour, but the sides of the head are lighter, and the chin and throat are nearly white. The inner surface of the limbs is also lighter, as well as the whole under surface of the body, the gray hairs having their distal half of a light fawn colour, and in some places nearly white. From the specimen having been for a long time preserved in spirits, it is difficult to get at the minute details of colour. There are no stripes or markings on the back, or other parts of the body, of this animal, as on the *Stenops tardigradus* of the East Indies; its general appearance being more uniform over the surface, although somewhat mottled in character, from the hair varying in colour at base and apex.

---

* A hand of the *Potto*, figured in "Cuvier's Animal Kingdom"—London, 1849 (Mammalia, &c., with Notes, by Edward Blyth), shows no such conjunction of the first phalanges, three distinct phalanges being figured in each of the fingers.

The Body of the *Angwántibo* is slender, and measures 10½ inches in length from the point of the muzzle to the extremity of the very short tail, which is completely hid in the long fur of the body, and measures only about ¼th of an inch in length. This animal is a male; the penis, which is supported apparently by a small bone, projecting upwards and forwards from the rounded scrotum.

The Head is oval and rounded, tapering rapidly in front of the eyes; the muzzle protruded, full or blunt, and rather prominent. The breadth of the head, in front of the ears, is about 1½ inch; in front of the eyes, about ¾ths of an inch. The length from the mesian line of the nose to the anterior part of meatus of ear is 1¾ inches; from point of nose to anterior angle of the eye is ¾ths of an inch; from anterior angle of eye to front of opening of ear, 1⅛ inch,—the total length of head from muzzle, to back part, being nearly 2½ inches. The Eyes are rather full and large, the opening of the lids measuring ½ an inch in length; the distance between the eyes at their anterior angles is ½ an inch. They are rather prominent forwards, and very slightly lateral. The Ears are erect and patulous, rather large, and rounded in outline, without emarginations, measuring about ¾ths of an inch across from before backwards, and also from above downwards; they seem to be naked internally, and slightly covered with short hair externally. In this specimen they are nearly naked, especially on the inner surface. There are two transverse, abrupt, parallel, projecting ridges of cartilage, each measuring $\frac{4}{12}$ths of an inch in length, in the free cartilage above the external opening of the meatus. The external openings of the Nostrils are rather lateral, and are sinuous, curved upwards and inwards toward the mesian line of the full and rounded snout; and there is a groove between them, running down to the front of the upper lip. The TONGUE is long, rounded in front, and rather rough, being covered with small papillæ. Immediately below the tongue is the projecting lamina, covered with a horny cuticle, and resembling a smaller, bird-like tongue, which springs from the frenum and projects forwards, about $\frac{3}{8}$ths of an inch in length. It is free at its edges, and at its point, which projects about $\frac{1}{8}$th of an inch; reaching to within $\frac{1}{4}$th of an inch of the point of the tongue itself. This horny lamina measures about $\frac{1}{4}$th of an inch in breadth across its root or base, and about $\frac{1}{8}$th of an inch across its free or front extremity, which is divided into nine sharp terminal points or filaments. The *P. Geoffroyi* is described by Bennett as having this horny lamina terminating in about six filaments. It is difficult to understand the use of this strange supplementary horny, bird-like tongue, or expansion of the frenum, with its pointed terminal filaments, in an animal stated to feed on fruit; it would seem rather to be some sort of additional assistance towards capturing or killing an insect prey; but, in any view, its use seems to be very obscure. Below the tongue and this supplementary organ, the mucous membrane lining the floor of the mouth has a slightly free margin projecting along the sides of the gums of the lower jaw; in which, apparently, the ducts of the submaxillary gland (Wharton's ducts) open into the mouth.

The NECK is rather short and slender. There is no appearance on the back of the neck in this specimen "of the spinous processes of the five last cervical and first dorsal vertebræ, piercing through the hairy integument of the back, with a weak horny covering," as described by Van der Hoeven of the *Stenops potto*.

The LIMBS are very slender, and nearly equal in length, the hinder extremities being a little larger and stronger in their development than the anterior. The FORE HANDS (see fig. 1 of the annexed careful drawings, nearly the size of life, for which I am indebted to my friend, T. Strethill Wright, M.D.) are thinly covered with short hair on the dorsal, and are bare of hair, or naked, on the palmar surface. The thumb is much larger than any of the other fingers, to which it is opposed. There is a large rounded, fleshy, and horny tubercle, nearly $\frac{1}{4}$th of an inch broad at its base, projecting about $\frac{1}{8}$th of an inch, from the base of the thumb, on the inner side (next the centre of hand). Immediately opposed to it, and of equal size, or a very little larger, is another apparently simple tubercle, rising from the outer side (next thumb), of the base of the clustered fingers (see * fig. 1); this, however, is the rudimentary index finger, its free extremity projecting only about $\frac{1}{8}$th of an inch. It is supported by a short metacarpal bone, with a full and rounded extremity, to which are attached *two* small or rudimentary phalanges; each of the other fingers (not including the thumb), having *three*. This rudimentary index finger has no nail; there is simply a minute marking, like a cicatrix, or rather a mere short, depressed, smooth line, an indication of where a nail should be. The nails of the thumb and other fingers are all thin, flat, and rounded or ovate, like those of the human hand, and are not extended beyond the points of the fingers. The remaining three fingers are slender and prolonged, and the first phalanges are all conjoined by the integuments, the two distal phalanges of each finger alone being free. The index or second finger (considering the thumb as a finger) is, as already described, merely like a tubercle rising at the base of the others. The third finger is the smallest of the other three fingers, and also the shortest; the fourth (or middle of the developed fingers) is the longest; and the fifth, or last, is longer than the third.

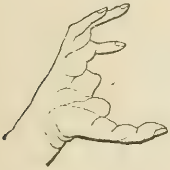


Fig. 1. Hand.

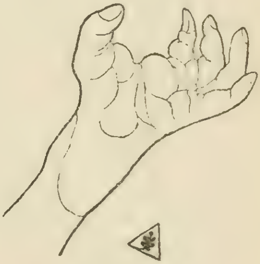


Fig. 2. Foot.

ANGWÁNTIBO.

The hands are each divided into two portions; the thumb, with the tubercle at its base, being opposed to the fingers with the tubercle-like index at their base: the thumb itself being brought into opposition to the fourth, the middle or longest of the fingers.

The *posterior hands* or *feet* (see fig. 2, which also shows the length of the tarsus) are rather larger and stronger than the anterior ones, and are each divided into two opposing portions; the one consisting of the thumb, with a large, rounded, fleshy tubercle projecting from the inner side of its base, as in the fore hand; and the other portion, formed of the remaining four fingers, the first phalanges of which are also conjoined, being covered by the integuments, as in the hand. There is a comparatively smaller fleshy tubercle, somewhat like the undeveloped index finger of the fore hand, projecting from the outer side of their base, which is opposed to the tubercle at the base of the thumb. It is not supported by any bone, but is merely a horny and fleshy projection like that on the base of the thumb. The nails of the thumb and fingers are thin, flat, and rounded or ovate in form, like those of the fore hand, with the exception of that of the second finger (counting the thumb as the first), which is narrow, convex, sharp-pointed, and claw-like, and extends nearly to the point of the third finger, this claw-like nail, indeed, constitutes one of the distinctive characters of the FAMILY. In the *P. Geoffroyi* of Bennett, the claw-like nail on the second finger appears to be 1 inch and $\frac{7}{10}$ths in length (the finger being stated to measure $\frac{8}{10}$ths of an inch, or, including the nail, 2 inches $\frac{5}{10}$ths); whereas, in the *Angwántibo*, the whole length of the free extremity of the finger is half an inch, including the claw-like nail, which measures rather less than a quarter of an inch.

The hands and feet have been already mentioned, as being each divided into opposing portions. They remind one of the zygodactylic feet of the Climbing-Birds; and this character, taken along with the existence of the *rete mirabile* of the limbs (the tortuous and anastomosing plexuses of vessels, which exist in this animal, as well as in others of its class), and the arboreal habits of the creature (for so completely does it dwell among the branches of trees, that it is stated by one of the missionaries to be scarcely able to walk on the ground)—all seem to tell of long-continued muscular action, a capability of taking a safe, sure, and long-enduring hold ; and, probably, like others of its class, of a stealthy step, which may enable it to steal upon, and hold fast, an active and vigilant prey. The incident mentioned by the missionaries, of the *Dwăn* seizing animals like the monkey, is very curious ; as we cannot help thinking they must be seized and held fast for a somewhat different purpose than merely to prevent them destroying the young and unripe fruit, on which they both are said to feed. The dentition of the *Angwántibo,* to be afterwards detailed, would make us incline to the belief of its food being of a more mixed character than simply fruit, and that it probably included at least insects or their larvæ (for the capture of which the peculiarly complicated lingual apparatus may afford special facilities) ; or possibly, the smaller birds, which, from its nocturnal habits, it may also steal upon and capture, while they are quietly roosting among the branches of the trees. The structure of the feet, however, and the apposition of the thumb to the middle of the fingers, seem to show an adaptation for seizing forcibly the twigs of trees, rather than for the purpose of capturing a prey.

I subjoin details of the dentition of the *Angwántibo* ; and also some of its admeasurements. For the relative measurements of the *Potto,* corresponding to those described of the *Angwántibo,* and showing their various differences, see Bennett's account of the GENUS *Perodicticus,* referred to already.

DENTITION.

UPPER JAW :—

Incisors 2 · 2=4. Two together (in pairs), with intermediate edentulous space.—1*st* incisor the smallest, the 2*d* nearly twice as large as the first.

Canines 1—1=2. Large and projecting downwards. The intermaxillary suture is described as being immediately in front of the corresponding teeth of the *Potto ;* these teeth are therefore undoubtedly canines, and when the mouth is shut, they pass immediately behind the small canines which project forwards alongside the incisors of the lower jaw.

Molars $\underline{6 \cdot 6}=12$.

(False Molars, 3.) 1*st*, smallest, conical; with very small and slight indication of an internal conical tubercle: 2*d*, conical; with small internal conical tubercle: 3*d*, with external conical tubercle; and smaller, shorter, internal tubercle.

(True Molars, 3.) 4*th*, with two external conical tubercles; and two internal smaller and flatter tubercles: 5*th*, two external conical tubercles; and two internal, smaller and flatter ones: 6*th*, two external conical tubercles; and one internal flattened and smaller tubercle.

LOWER JAW:—

Incisors $\overline{2 \cdot 2}=4$. In pairs laid closely together, the pair appearing like one tooth, and all sloping forwards.

Canines $\overline{1 \cdot 1}=2$. Small, sloping forwards adjoining incisors, which they closely resemble. Each tooth, however, is slightly larger in size than a pair of the incisors.

Molars $\overline{6 \cdot 6}=12$.

(False, 3.) 1*st*, large, conical, projecting forwards and upwards like a canine tooth in shape (the corresponding tooth in the *Potto* was formerly described as a canine tooth). When the teeth are closed, the canine of the upper jaw passes in front of this tooth, it is therefore the first molar; 2*d*, smaller than first, shorter, conical, and pointed forwards; 3*d*, rather larger than second, conical.

(True, 3.) 4*th*, two external and two internal tubercles, nearly equal in size; the internal rather the largest; 5*th*, two external; and two internal and rather larger tubercles; 6*th*, two external; and two internal tubercles, nearly equal, and less defined; with another smaller tubercle behind.

$$\overset{\text{Incisors.}}{\frac{2 \cdot 2}{2 \cdot 2}=\frac{4}{4}}; \quad \overset{\text{Canines.}}{\frac{1 \cdot 1}{1 \cdot 1}=\frac{2}{2}}; \quad \overset{\text{Molars.}}{\frac{6 \cdot 6}{6 \cdot 6}}=\frac{12}{12}=\frac{18}{18}=36.$$

Length of Body, from muzzle to point of tail, 10½ inches; tail, ¼ an inch, including fur, ½ an inch.

ANTERIOR LIMBS:—

Length of Arm $2\frac{1}{4}$ inches; *Fore-Arm,* not including hand, $2\frac{1}{4}$ inches.

Hand.—The first phalanges of the fingers are covered and conjoined by the integuments of the hand, the two distal bones being the only ones that are free; length from wrist to point of fourth or longest finger, $1\frac{1}{4}$ inch.

Length of Thumb, or First Finger, from wrist, $\frac{3}{4}$ths of an inch: of this, there is a free extremity of $\frac{1}{2}$ an inch in length.

Length of Index or Second Finger.—Metacarpal bone of index finger measures $\frac{3}{12}$ths of an inch in length. The first phalanx measures $\frac{2}{12}$ths of an inch, and the distal phalanx $\frac{1}{12}$th of an inch in length; the metacarpal bone of index finger and first phalanx being, together, the length of the metacarpal bone of the second finger. The metacarpal bones of the other fingers measuring about $\frac{5}{12}$ths of an inch in length. Free extremity of finger about $\frac{1}{8}$th of an inch.

Length of Third Finger from wrist, $\frac{3}{4}$ths of an inch. The first phalanx of third finger measures $\frac{4}{12}$ths of an inch; the second phalanx less than $\frac{3}{12}$ths of an inch; and the distal one rather less than $\frac{2}{12}$ths of an inch. Free extremity is $\frac{1}{4}$ of an inch.

Length of Fourth Finger from wrist, $1\frac{1}{4}$ of an inch. The first phalanx is nearly $\frac{6}{12}$ths of an inch long; the second, $\frac{4}{12}$ths of an inch; and the third, about $\frac{3}{12}$ths of an inch. Fourth finger longest, free extremity $\frac{1}{2}$ an inch in length.

Fifth Finger.—Length from wrist 1 inch. The first phalanx is about $\frac{5}{12}$ths of an inch in length; the second, $\frac{3}{12}$ths of an inch; and the third about $\frac{2}{12}$ths of an inch. Free extremity $\frac{3}{8}$ths of an inch.

SPAN, 1 inch and $\frac{8}{10}$ths of an inch.

POSTERIOR LIMBS:—

Length of Thigh, $2\frac{1}{2}$ inches; *of Leg,* $2\frac{1}{2}$ inches.

Foot, from ankle-joint to point of longest finger or toe—the fourth, $1\frac{1}{2}$ inch. *Tarsus,* not elongated, about $\frac{1}{2}$ an inch in length. *Metatarsal bones* measure from $\frac{5}{10}$ths to $\frac{6}{10}$ths of an inch in length.

The first phalanges (with the exception of the thumb), like those of the hand, are conjoined together.

Thumb or First Finger.—Thumb with metatarsal bone, about $\frac{7}{8}$ths of an inch long. First phalanx, $\frac{6}{16}$ths of an inch; second, $\frac{4}{16}$ths of an inch.

Length of Second Finger, 1 inch; first phalanx, nearly $\frac{2}{8}$ths of an inch; second phalanx, $\frac{3}{16}$ths of an inch; third phalanx, bone of claw, $\frac{4}{16}$ths of an inch; claw itself, $\frac{3}{16}$ths of an inch. Free extremity, $\frac{1}{2}$ an inch.

Length of Third Finger, first phalanx, $\frac{7}{16}$ths of an inch; second phalanx, $\frac{4}{16}$ths of an inch; third phalanx, $\frac{3}{16}$ths of an inch; third finger smaller than the fifth, and free about $\frac{3}{8}$ths of an inch.

Length of Fourth Finger, first phalanx, $\frac{4}{8}$ths of an inch; second phalanx, $\frac{3}{8}$ths of an inch; third phalanx, $\frac{3}{16}$ths of an inch; fourth finger longest, free about $\frac{1}{2}$ an inch.

Length of Fifth Finger, first phalanx, $\frac{4}{8}$ths of an inch; second phalanx, $\frac{5}{16}$ths of an inch; third phalanx, nearly $\frac{3}{16}$ths of an inch. Larger than third finger, being intermediate between it and the fourth, and free for about $\frac{3}{8}$ths of an inch.

SPAN measures nearly 2 inches in length.

This animal possesses a clavicle. The stomach is moderate in size, and rounded in form, and contained what seemed to be digested vegetable matters. It has a large sacculated cœcum of about $1\frac{3}{4}$ths inch in length.

MICROSCOPIC STRUCTURE OF THE HAIR OF ANGWÁNTIBO.

On examining through the microscope some of the hairs of this little animal, I was much struck by their apparent variety and beautiful cellular structure. Plucking a few at random from the upper surface of the body, I found I had got three different varieties: large flattened hairs, showing a combined series of cells; smaller hairs, containing a single series of cells; and each displaying the external or epithelial coating of the hair, which forms a series of overlapping margins or scales, their free edges being directed towards the points of the hair; and, lastly, small bent or curved solid horny-like hairs, with this overlapping external coating developed here and there into large hook-like processes or spines. At my request, my friend Dr T. Strethill Wright made a minute microscopical examination of these hairs, and sketched the accompanying careful drawings (see Plate III.), which show very well their beautiful structure. Dr Wright used simply water in examining some of the hair; and this fluid entering by the cut extremities, and permeating the hair thoroughly, distinctly revived and exhibited their internal cell structure. In the smaller-sized hair, containing only one series of cells, the cells are found to have an hour-glass contraction in the middle, the lower half of the cell containing the colouring-matter of the hair, and the upper part of the cell displaying a distinct central nucleus, the existence of which, at least in the body of the hair, is a fact which was new to both of us, if not altogether new to microscopists in general? These nuclei were also beautifully seen in the cells of the larger hairs. Dr Wright has figured (Plate III. fig. 4) the peculiar appearance which some of the hairs displayed, of black bars, arranged in a somewhat parallel manner, or zig-zagging from one extremity to the other, in the central portions of the bodies of the hair; for the lower, and upper portions of all the hairs, showed no cell cavities, being formed apparently of solid structure. These black bands were due to some of the uncut hairs being mounted in turpentine or balsam, which did not permeate the hair like the water, but obscured their true structure altogether, by enclosing the air as a black band, which was varied both in shape and contiguity, in the lacerated cells of the hair.

Thick hair or fur of a cellular structure containing thus enclosed a considerable amount of atmospheric air, a bad conductor of heat, and therefore useful in preventing the rapid cooling of the body of the animal, has been believed to be peculiarly adapted as a covering for animals inhabiting cold climates; it seems, however, to be not inappropriately found on this little animal, which is stated to search for its food by night, and is therefore exposed to the damp and cold which occur at night in even a tropical forest.

Annexed is Dr Wright's detailed description of Plate III.

DESCRIPTION OF PLATE III.

Fig. 1. Proximal portion of small hair in water, showing the recurrent spines.

2. Middle portion of small hair in water, showing hour-glass-shaped cells, one-half of which is occupied by pigment, the other by the nucleus and vacuolated "cell-contents." Diameter about ·001 inches.
3. Summit or solid portion of large hair, showing contracted scales.
4. Upper part of large hair in turpentine, showing dark spaces filled with air, formed by the shrivelling of the cell contents, of single and double row of cells. Diameter about ·006 inches.
5. Middle or broadest part of large flat hair in water, showing single layer of cells, with nucleus and vacuolated cell-contents. Diameter ·009 inches.

The Society may think I have entered rather too much into minute details of description. My reason for doing so, is to leave no doubt on the mind of any one, who may wish to make comparisons between this *Angwántibo* and any other individual of the genus, as to the special animal I have attempted to describe; and, for preservation, it is my intention to deposit the specimen in the Natural History Museum, University.

Since the preceding pages were written, I have been fortunate enough to get this specimen of the *Angwántibo*, and my detailed description, compared with the *Potto* described by Mr Bennett; and also with other specimens of the *Potto* in the collections of the British Museum—my friend, Mr William Carruthers, of the Botanical Department of that great national institution, having, at my request, kindly taken the trouble of examining them.

Mr Carruthers informs me I am correct in my opinion of the *Angwántibo* being a distinct species from the *Potto*, the *Perodicticus Geoffroyi* of Bennett; and also that it is a species apparently unknown to naturalists. I am therefore at liberty to designate it the *Perodicticus Calabarensis*.

Mr Carruthers says:—"It is certainly a *second* species of *Perodicticus*. I compared it with two stuffed specimens of the *Potto*, and, with the assistance of Dr Gray, determined that it was *new*, differing chiefly from *P. Geoffroyi* in its tubercle-like tail and large ears. I also got Mr Bennett's specimen of the *Potto,*—which is yet fortunately in spirits,—and have been able more completely to discriminate the differences."

At my desire, an artist made sketches of the head of Mr Bennett's specimen of the *Potto*, and also of my specimen of the *Angwántibo*, to show the various differences between them, in a more manifest way than by any lengthened description; and as both the specimens have been preserved in spirits, these comparative differences are seen at a glance, no change in the original appearance of either having been made by any attempt at skinning, or otherwise preparing them for preservation. The sketches are of the natural size, and very accurate, being drawn without any attempt to put

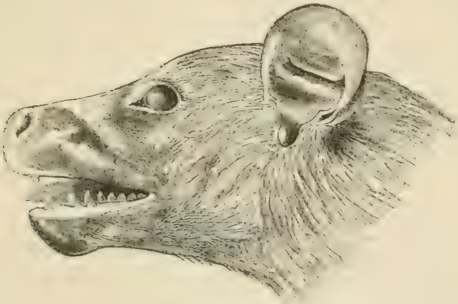


Fig. 3. Head of Angwántibo

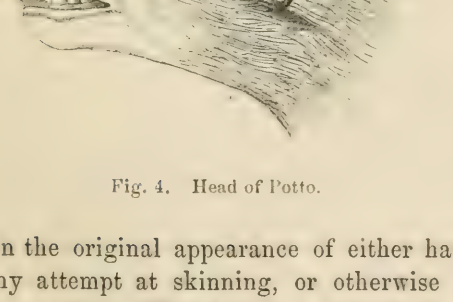


Fig. 4. Head of Potto.

the hair in its natural position. In this way two things are gained. First, both specimens are exhibited as they really are, without any exercise of the imagination of the draughtsman ; and, secondly, the outline of the skull is given in both, which is of much more importance than the outline of the hair, in animals where the hair is thick and stands nearly erect. The preceding woodcut (fig. 3), is the sketch of the head of the *Angwántibo*, the other (fig. 4), that of Mr Bennett's specimen of the *Potto.*

In pointing out the various specific differences which the comparison of the two specimens make manifest, Mr Carruthers says, in the *Angwántibo* the body and limbs are more slender than in the *Potto*, and the colour of the hair is more uniform. The head is longer and narrower, with a more produced muzzle, larger mouth, and more prominent eyes; while in the *Potto* (see woodcut), the head is nearly round, and has a much less projecting muzzle. Again, the ear is larger, and directed more upwards and forwards in the *Angwántibo;* and there are two folds, as already pointed out, in the inner surface of the ear; while there is only one in the *Potto*. The drawings show also the remarkable differences in the teeth. The teeth in the lower jaw, which Bennett described as the canines in the *Potto*, but which are now considered as pre-molars, are mentioned by him as having cutting surfaces, both before and behind, they are, in fact, small, flat, triangular teeth ; whereas in the *Angwántibo* they are long, rounded, and more canine-looking. Then the six teeth in the front of the lower jaw, in the *Angwántibo*, are small and hyaline, not visible above the under lip ; while in the *Potto* they are large, prominent, and projecting (see woodcuts), and of the same colour as the molars.

There is also a very striking difference in the hands of the two little animals. Mr Carruthers has been good enough to make the annexed careful sketches, the size of life, of the hand (fig. 5), and the foot (fig. 6), both belonging to the left side, of Mr Bennett's specimen of the *Potto*, (see woodcut, figs. 5, 6); and on comparing these sketches with those already given of the *Angwántibo*, which, for comparison, I here repeat (figs. 1, 2), the differences will be seen more clearly than could be brought out by any description. In the *Angwántibo* the hands and feet are small, round, and fleshy, with several large pads; in the *Potto* they are large, flat, and thin. In both, as has been already carefully described, the index fingers of the fore hands are undeveloped; being represented in the *Angwántibo* by a simple tubercle (see * fig. 1.) In the *Potto*, however, as shown in the drawing, the index is not so like a mere tubercle, but is more developed, and therefore more resembling a finger, than in the *Angwántibo*, (See * fig. 5.)

The tail is perhaps the most striking distinguishing character. I have already sufficiently described it.

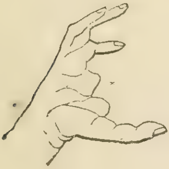


Fig. 1. Hand.

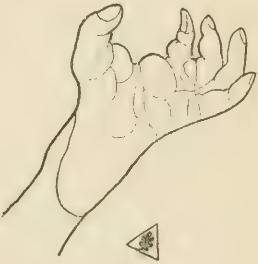


Fig. 2. Foot.

ANGWANTIBO.

Mr Carruthers informs me that when examining the different species of Van der Hoeven's genus *Stenops*, in the British Museum, he was struck with the great diversity of their general appearance, and was astonished that a zoologist like Van der Hoeven grouped together what appeared to him to be several well-marked *Genera*. Indeed, the only explanation that occurred to him was, that Van der Hoeven intended to give the character of a SUB-FAMILY to his *Genus* Stenops.

While comparing the specimens of these two animals, he had on his table all that had been published on the *Potto*. Bosman's figure is a grotesque caricature of a fat and lazy animal, having a very faint resemblance to the *Potto*. Van der Hoeven gives a drawing of the skull in the "Tydschrift voor Nat. Gesch.," vol. ii. plate i. fig. 3, and of a young animal, in plate ii.; also a very full account, with drawings of an adult, and of the skeleton, brain, and viscera, in a paper in Verhand. der Eerste Klasse van het Kon. Med. Inst. IV. 1851. More recently, in 1856, Dahlboum, in his "Studia Zoologica," gives a figure and description of the *Potto.* He divides the *Lemuridæ* into three sections. First, the true *Lemurs,* with long tails; second, the *Lorids* (stenops), without tails, and with long limbs; and third, those with very short tails, or almost tail-less, oval or globose heads, and short fleshy arms. Here he has two genera: I. *Perodicticus*, characterised thus: "Caput ovale, ore crasso obtuso. Aures liberæ. Oculi subparvi. Index manus anticæ abortus, in tuberculum coarctatus." And, II. *Nycticebus,* "Caput globosum, ore conico. Aures in pelle absconditæ occuli magni. Digiti normales."

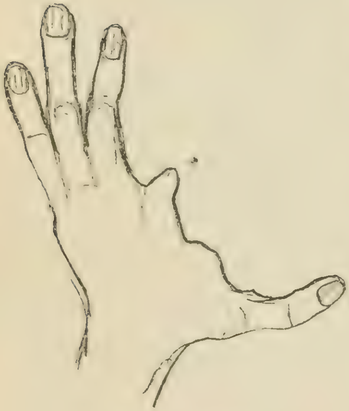


Fig. 5. Hand.

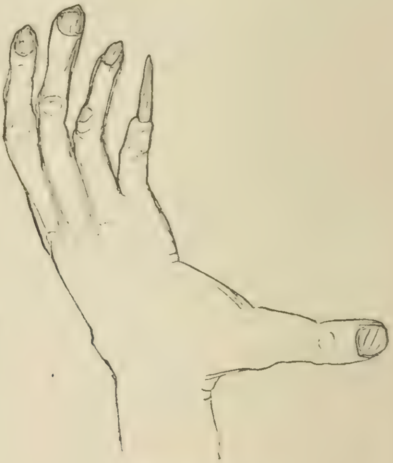


Fig. 6. Foot.

Potto.

I may mention, in conclusion, since this paper was in type, I find that Van der Hoeven made a short communication on the *Potto* to the Meeting of the British Association in 1850, and a second on the anatomy of the *Potto* in 1860, in which he refers to a complete monograph of this animal published by him in 1859, in the seventh volume of the Transactions of the

Royal Academy of Sciences of the Netherlands (Ortleedkundig Ondersock van der Potto van Bosman door F. A. W. Van Campen Med. Cand. Uit due Platen Amsterdam. 4to, 77 pp.) Van der Hoeven also details his arrangement of the *Lemuridæ*, published in his "Handbook of Zoology," and refers again to the peculiarity in the *Potto*, "that some of the spinous processes of the neck, covered only by a thin corneous epiderm, pierce through the fur-like prickles. They are those of the fifth to the last cervical, and of the first two dorsal vertebræ." These projecting processes are evident, Mr Carruthers informs me, in Mr Bennett's specimen, though, probably from its youth, neither so numerous nor so strongly marked as Van der Hoeven describes them. They cannot be detected in the two *stuffed* specimens in the British Museum, as might have been expected; as already stated, I could not discover this peculiarity in my specimen of the *Angwántibo.*

I have been recently favoured with the following explanation of the name *Angwántibo*, from the Rev. Alexander Robb :—"The name *Angwá-ntibo* is compound ; the first part is the same as the name of the domestic cat, which the Calabar people call *Angwá*, or *Angwá-mbána*—the *ng* being a very soft nasal sound. *Angwá* is probably onomatopoetic, from its resemblance to the sound of the mew or cry of the cat. The meaning of *ntibo* is unknown to me. The *Angwántibo* is, therefore, so named, probably because it is supposed to resemble the cat, either in its cry or in some of its habits. We give this note as a correction of the etymology proposed in the letter at the beginning of the above paper."

REVIEWS AND NOTICES OF BOOKS.

Vis Inertiæ Victa; or, Fallacies affecting Science: an Essay towards increasing our knowledge of some Physical Laws, and a Review of certain Mathematical Principles of Natural Philosophy. By JAMES REDDIE. London: Bradbury and Evans. 1862.

It is a curious peculiarity of the present age, so distinguished above its predecessors for the diffusion of knowledge on almost every subject—that perpetual-motionists and squarers of the circle, as well as trisectors of angles and duplicators of the cube, are becoming more numerous day by day. Within the last month we have been favoured with communications from four inventors of self-sustaining engines, and two of methods of obtaining eight or ten horse power from one horse. We have also had mysterious hints about the area of a circle; and have been asked whether the fortunate discoverer is not entitled, by the universal law of nations, to a reward of one million sterling. But all these communications have been sent to us in trust, the happy authors hoping that their secret would be safe with us. So it is and shall be. Unread, or but glanced at, the precious pages have been torn into pipe-lights, the waste-basket seeming scarcely to afford the honourable silence demanded. Thus has perished in its innocence the progeny of many a simple mind, the result, perhaps, of years of persevering but misdirected toil.

In the present instance, however, we are called upon publicly to pronounce upon the merits of a tremendous discovery, destined, as its author sadly fears, to strip the overrated Newton of his undeserved honours, and to revolutionise at once the laws of nature and the processes of mathematics. Here is no timid discoverer shrinking from the light of day, blushing to find himself famous; but, instead, the calm consciousness of power, and the kindly patronising language of unquestioned superiority.

In his superhuman struggles with the *Vis Inertiæ,* Mr Reddie has laid about him so freely in all directions, that the laws of motion, gravity, heat, cohesion, and a host of other still less interested spectators, have had their share of the slashes. Nothing is secure, and we rise from a perusal of his book with a dreamy consciousness that something has gone wrong; that there is a screw loose somewhere, whether in the system of the universe, or in the brains of a Newton—or a Reddie.

But let us look a little closer into matters. The following seems to be the sentence which has suggested the title of the volume:—§ 22, "On this hypothesis the term *Vis Inertiæ*, applied to matter, is meaningless." Again in § 23, about the case of a horse dragging a stone, we find the assertion that when the stone is so heavy that the horse cannot move it, this is due to weight *exclusively ;* previous cases having been mentioned in which friction was allowed to have a share. We are immediately told that all this is inconsistent with the third law of motion ; hence the latter also falls, along with the unfortunate *Vis Inertiæ.* In all this, at least so far as we can see, there is nothing advanced but hypothesis and assertion, not always quite concordant. Did Mr Reddie ever try to open a massive iron gate, or to deliver a large curling stone ? Had the weight of either body anything to do with the difficulty he experienced in handling it ? Did he ever try to stop a large grindstone set in rapid rotation, or was he ever struck by a cricket-ball ? We fear he has not been, or he would reverence the recollection of the *Vis Inertiæ.* Does our instructor believe in the *mass* of the earth, or does he speak of its *weight*, and if so, how is he to determine it ? Would a stone be a whit less massive if there were no earth to attract it ? But we fear we are assuming the function of mentor, instead of imbibing meekly and gladly the great lesson he is teaching. And this is its moral, so far as we are able to judge :—"Learn natural philosophy from the popular scientific works of the day, Mechanics for Schools, Hydrostatics and the Use of the Globes for her Young Friends, by an Old Lady, &c. &c. They swarm on every counter—buy *them* and learn. Newton, Laplace, and Faraday, though clever men on the whole, came to the study of the simplicity of nature with minds biassed and distorted by untrustworthy mathematics, or the still more dangerous snares of hypothesis. Till they lay aside what has been heretofore supposed to constitute their especial fitness for the work, all that they may do or say must be erroneous." Great art thou, O Reddie ! and in thee is no deceit at all.

We have not space to examine much more of the new theory. Centripetal force has been utterly misunderstood till now (§ 80). We find that we were blindly mistaken when, a few years ago, we heaped a "torrent of ridicule" on the ingenious discoverer of the moon's having no rotation about her axis (§ 77). The note to § 112 we were almost tempted to extract in full ; such a mass of astounding novelty it would perhaps be difficult to find elsewhere in so small a space. But we prefer extracting, from the note to § 100, a trembling anticipation of a possible law of hydrostatics which even *we* must allow is likely to be true, though we imagine we have read it elsewhere, and fancy Archimedes had something to do with it ; but we are in all probability mistaken : "If a stone be weighed with a spring-balance in water, and in air, I apprehend its normal weight would differ ! ! " Why the spring-balance is required Mr Reddie does not think it necessary to inform us ; and we cannot gather it from the rest of his note, which, like the first mention of almost all great discoveries, is singularly obscure.

A body acted on by gravity moves in a parabola (or, as it is sometimes called (§ 106), a paraboloid). Hence it is impossible that it could move in a circle about the earth's centre (§ 105). § 144, "There is much to be said in favour of reverting to the old notion of a central earth, surrounded by its glorious canopy and hosts of revolving lights, as after all most probable." Central earth —revolving lights! Shades of Copernicus and Lighthouse Commissioners! Peace to your honoured manes; let no earthly or spiritual considerations tempt you to revisit the glimpses of the moon, for she revolves not, neither does the earth, and even the catadioptric apparatus is superseded by blinking stars. Advance, ye legions of the apostolic M'Hale, an era of superstition is again at hand; and, after all, we may find that the moon is no bigger and no rounder than a loo table.

One extract more, and we finish. § 30, "There is a great temptation to generalise still further, and assume that COLD and gravitation are in their essence and ultimate principle the same!" We have recently been reperusing, for the twentieth time, a remarkably clever but disagreeable novel—one written many years ago, but still, we are happy to think, affording both pleasure and profit to a host of readers. We close with a paragraph from it, which has somewhat more than a mere resemblance to the above § 30 of Mr Reddie's treatise:—

"Researches into Physical Science, with a view to the Establishment of a New Principle, LIGHTNESS. By Diabolus Gander, Esq., Ph.D, &c. &c."

Let the candid reader make a mental comparison, and may it tend to his enlightenment, helping him to estimate at their true value the class of works of which that we have before us is a very favourable specimen.

De Candolle, Prodromus Systematis Naturalis Regni Vegetabilis, sive Enumeratio contracta ordinum, generum, specierumque plantarum hucusque cognitarum, juxta methodi naturalis normas digesta. Editore et pro rata parte auctore ALPHONSO DE CANDOLLE. Pars decima quinta, sectio posterior. Fasc. 1, 8vo. Parisiis. Masson et Filii. Januario, 1862.

The present part of this valuable work contains descriptions by Boissier of some of the plants belonging to the natural order Euphorbiaceæ. It embraces, Tribe I, Euphorbieæ, in which the male flowers are not calyculate. Of the genus Pedilanthus 15 species are noticed, of the genus Euphorbia 723 species, and 2 species of Synadenium. The genus Euphorbia is divided into 27 sections. There is an excellent and useful index of the names and synonymes of this extensive genus. We sincerely trust that

M. Alphonse De Candolle may be spared to complete this important work, which was commenced by his illustrious father. We learn, however, that the distinguished author has no intention of entering on the Monocotyledonous orders. It may be hoped that his son Casimir, who has already published some good botanical papers, will continue the "Prodromus," with the assistance of able botanists.

De la Production Naturelle et Artificielle du Liège dans le Chêne-Liège. Par M. Casimir De Candolle. Genève, 1860.

The cork of commerce is derived from two species of Quercus. 1. *Q. occidentalis*, Gay, which grows in the south-west of France and in Portugal, and which is recognised by its acorns taking two years to ripen; 2. *Q. Suber*, which grows in the south-east of France, in Italy, and in Algeria, as well as in the islands of the Mediterranean. M. Casimir De Candolle, representing the third generation of botanists of that name, paid a visit to Algeria, and examined the development of the cork in the latter species. He has given the results of his observations in this paper. There are four layers—the epidermis, the corky layer, the cellular layer, and the liber. The development of these layers is traced through their various stages in an able manner, and the remarks are illustrated by well-executed drawings. It appears that the corky layer formed naturally has little commercial value. It is removed, and then a new corky layer is formed, which is much finer and more elastic. This constitutes the cork of commerce. At the end of seven or eight years, this layer attains sufficient thickness, and it is then removed. The author gives full details of the mode of growth of the cortical layers; he describes their microscopical structure, and points out the mode in which the best qualities of cork are produced. The essay indicates botanical acumen and powers of microscopical observation which give promise of good fruit in future years.

PROCEEDINGS OF SOCIETIES.

Royal Society of Edinburgh.

Monday, 6th January 1862.—The Hon. LORD NEAVES. Vice-President, in the Chair.

An address of condolence to Her Majesty, on account of the death of his Royal Highness the Prince Consort, was adopted by the Society ; and the Secretary was directed to transmit it, after receiving the signature of the President, to Sir George Grey, Principal Secretary of State for the Home Department.

The following Communications were read :—

1. On the Climate of Palestine in Modern compared to Ancient Times. By Principal Forbes.

(This Paper appears in the present number of this Journal.)

2. Biographical Notice of Andrew Dalzel, Professor of Greek in the University of Edinburgh. By Professor Innes.

Professor Dalzel was born in 1742, at Gateside of Newliston. His father died while he was still an infant, and he was educated partly by his uncle, the minister of Stonykirk, in Galloway, and after *his* death, by his mother, at Newliston. He attended the parish school of Kirkliston, and from thence went to college at Edinburgh. His companion at both was Robert Liston, afterwards Sir Robert, the ambassador. The boys began life together. Liston was just two days younger than his friend, and the intimacy of school and college lasted through life. It is chiefly from the correspondence kept up between them from 1766 till 1805 that the present Memoir has been compiled.

On leaving college, Dalzel was for some time tutor in the family of Lauderdale, and the friendship so commenced also remained firm and unbroken through life.

In 1772–73, partly by an arrangement with his predecessor, partly through the influence of the Lauderdales with the Town Council, Dalzel became Professor of Greek in the University. The study of that language had fallen much into decay in Scotland, and Dalzel set himself zealously to the task of restoring and promoting it. He devoted himself to the duties of his class, and was soon rewarded by its increase in numbers and improvement in study. Among other means for his object, he set about preparing some class-books for Greek students which were then unknown. His first publication was a little supplement to Moor's Grammar, under the title of *Fragmenta Grammatices Græcæ in usum tironum in literis Græcis in Academia Edinensi.* The prose volume of his well-known *Collectanea Majora* was published in 1785, and got almost at once into favour with the best teachers here and in England.

In the immediate duties of his professorship Dalzel was indefatigable. Dr Monro said of him, that "he had more to brag of than any man in the college, for that Greek was going fast down-hill till he revived it." His second volume, the poetical portion of the *Collectanea Majora*, cost him great labour, and obtained the assistance of many friends among the best scholars of England. Though long promised and urgently called for by the schoolmasters and "the trade," it was not published till 1797. It was then received with as much favour as its predecessor; and the two volumes rapidly came to supersede all other class-books for Greek students. Both volumes passed through many editions, and perhaps wanted nothing for permanent success and popularity, but that the valuable information conveyed in the notes should have been given in English instead of Latin, which the practice of the time seemed to require.

Dalzel married, in 1786, Anne, daughter of Dr John Drysdale, the well known clerk of the General Assembly, and one of the leaders of the Church. His marriage connected him with the Adams, Principal Robertson, the Kennedys of Dunure, the Broughams, Elliots of Minto, and the rest of that remarkable group of Edinburgh families. His professorial position brought him into intimate acquaintance with the philosophers and scholars who then made our University famous. His labours in publishing books for his class, connected him with many distinguished scholars; and a good deal of his correspondence is preserved and used for this Memoir. It embraces letters from Heyne, Böttiger, Porson, Parr, Bishop Burgess, Dr Raine of the Charterhouse, Tate, the excellent master of Richmond school, Thomas Young, the scientific philosopher and universal scholar.

The Memoir has frequent notices of the commencement and progress of the University buildings, and other academic matters; including the first *Symposium Academicum*, the death and character of Principal Robertson, the commencement of the Society of Antiquaries, and in connection with it, the foundation of the Royal Society, of which Dalzel was an original and active member. It notices also some passing events; such as visits of remarkable persons to Edinburgh, the impression made by Burke, by Burns, by Mrs Siddons, &c.

But the chief object of the Memoir, as of Dalzel's whole life, is the restoration of Greek and classical education in Scotland. The writer gives his reasons for preferring a classical discipline to either a purely metaphysical or a merely physical course of education, formerly and now preferred among us.

Dalzel's character was singularly amiable. Living in factious and contentious times, in a society not always peaceful, he courageously avoided all quarrels, and gave his whole energy to his duty. In society and his family he was equally fortunate and beloved; and his life is an example of happiness uninterrupted, arising from successful devotion of talents to a worthy object. Dalzel died on the 8th December 1806.

Monday, 20th January 1862.—JAMES T. GIBSON-CRAIG, Esq., Treasurer, in the Chair.

The following Communications were read :—

1. Note on the Phosphorescence of Beröe. By Professor Allman.

The author stated, as the results of some experiments which he had made on the phosphorescence of a species of *Beröe* (*Idyia*) which abounded during the last summer in the Firth of Forth, that the light is never emitted as long as the animal is exposed to daylight; and that withdrawal from the daylight for some time is necessary, in order to impart to the Beröe the property of phosphorescence.

A glass jar, containing several living specimens of the Beröe in sea water, was removed from the daylight into a dark room, when not the slightest indication of phosphorescence could be detected, though the animals were subjected to precisely the same kind of irritation as is found to be always followed by the emission of light during the night. But after the Beröes had remained for about twenty minutes in the dark, the phosphorescence had become as vivid as by night; the slightest irritation would call it forth, and the vibration communicated to the jar by a blow on the table where it lay, was sufficient to cause the emission of a vivid flash of beautiful greenish light.

The author was aware that a source of fallacy might exist in the want of sensitiveness in the experimenter to faint luminous impressions, immediately after exposure of his own eyes to ordinary daylight; and accordingly no conclusion was arrived at as to the absence of luminosity until the eye was rendered sufficiently sensitive by confinement for some time in the dark room.

The absence, then, of luminosity in these animals during the day, is not due alone to the phosphorescence being rendered invisible by the stronger daylight, but to the fact that no light whatever is at that time emitted by the animal.

The author also stated that the embryo, while still included within the egg, is eminently phosphorescent, and that the emission of the light is subject to exactly the same conditions as in the adult. He was of opinion that the ova and free embryos of the Beröe and other Ctenophora, are among the chief sources of the phosphorescence of the sea in our latitudes—an opinion which finds support in the immense number of ova produced by these monœcious animals, taken in connection with the countless multitudes of Ctenophora which at certain seasons of the year crowd the seas round our coasts.

2. Contributions to our Knowledge of the Structure and Development of the Beroidæ. By Professor Allman.

In this communication the author gave the results of some careful observations and dissections he had made of a species of *Beröe* (*Idyia*), obtained in abundance during the last summer in the Firth of Forth.

In the anatomy of the adult animal, several points were described which seem to have been hitherto either overlooked or imperfectly examined. In the digestive system, the author noticed the presence of two richly ciliated membranous semi-elliptical flaps, which just before the stomach terminates in the narrow neck which leads into the bifurcating funnel, spring from its walls, and extend, by their free extremities, into the neck and commencement of the funnel. The equivalents of these flaps will doubtless be found in the two lips noticed by Milne Edwards in a similar position in *Beröe Forskalii;* and the author is of opinion that they are also the homologues of the two membranous appendages described by M. Edwards, in the stomach of *Lesueuria vitrea.* He also described the peculiar rod-like cilia noticed by Agassiz, as extending over the whole of the inner surface of the stomach, but which the author finds, in the specimens examined by him, to be confined to a broad band commencing just within the mouth, the remainder of the stomach walls being covered with ordinary cilia, which are very minute except on the contracted neck, where they become long and powerful. Peculiar enigmatical bodies were described as being present in the walls of the ramified cæca which spring from the meridional canals. They are in the form of minute cushion-like discs, which are prominent upon the external surface of the cæcal tubes. The disc is depressed in the centre, and from this depression a little conical elevation projects into the surrounding tissue of the animal. The cæcal tubes are also partially invested by a peculiar layer which extends over irregular spaces of their walls. This layer has been regarded as an extension of the ovary, but the author views it as an entirely independent structure. It is composed of minute cells, and may possibly be an eliminating organ.

A highly-developed system of capillary tubes was described in detail, as constituting one of the most interesting features in the structure of *Beröe*. These tubes seem to have been noticed by Gegenbaur,* who describes a network formed by the anastomosing offsets of cells, and which, in very young individuals, represents a system of repeatedly anastomosing tubes. They seem to constitute the same structure as that which Agassiz at one time† described as muscular fibres in *Cydippe*—an opinion, however, which he subsequently retracts, preferring, in his latest works,‡ to regard them as merely the optical expression of the walls of very large cells. The author has no hesitation in maintaining that these are all delicate capillary tubes, but without true anastomosis. They are divisible into four sets, differing from one another in their deeper or more superficial position, and in the general direction of their course. He believes that they may be conveniently divided into the following sets :—

1. Longitudinal.
2. Superficial circular.
3. Deep circular.
4. Gastro-parietal.

In the gastro-parietal set, especially, which extend from the walls of the stomach towards the external surface of the body, he had no difficulty in demonstrating a true tubular structure. Under stimulation they contract longitudinally, and become thickened transversely; and then they are plainly seen to be thick-walled tubes whose cavity encloses a granular matter. The tubules composing the other three sets seem to be also contractile, though this property is not so apparent in them as in the gastro-parietal set. All the four sets depolarise light, and present a similar appearance under the polariscope.

To the two oval ciliated spaces, situated one at either side of the ocellus, the author gave the name of tentacular discs. The margin of each disc is marked by a double line, on whose interval is borne a series of short hollow tentacular processes, simple in young specimens, but irregularly lobed or ramified in adults, covered over their whole surface with fine actively-vibrating cilia, and containing numerous pigment cells in their walls. The double line marks the boundary of a canal which runs round the disc upon its deep surface, and into which the bases of the tentacles open, the canal ceasing to be continuous at the inner extremity of the major axis of the disc, where there is a short space destitute of tentacles. The author maintains that the cavity of the tentacles, and their common basal canal, communicate, through the bifurcations of the funnel, with the general gastro-vascular system.

---

* Studien über Organisation und systematik der Ctenophoren. Wiegmann's Archiv, 1856.

† On the Beroid Medusæ of the Shores of Massachusetts. 1860.

‡ Contributions to the Natural History of the United States of America. Vol. III. 1860.

Eight chord-like organs have been noticed by observers, and have been described in detail by Agassiz as extending from beneath the ocelliform body to the extremities of the eight meridional bands; but the fact has not been hitherto noticed, that where they lie upon the cushion-like body which supports the sense capsule, they coalesce two and two, so as here to be but four in number. These four chords are clothed with true vibratile cilia. The author also described two additional chords, which originate also beneath the ocellus, one at each side, exactly opposite to the tentacular discs, and thence running outwards without dividing, lose themselves in the discs. These, like the former, are clothed with vibratile cilia. The true origin of the chords he believes to be in a ganglion-like tubercle which lies immediately under the sense capsule, and between it and the cushion-like body. Contrary to the opinion of Agassiz, the author regards these chords as truly representing a nervous system.

The author described four spherical tubercles, situated two upon each side of the cushion-like body, and between it and the tentacular discs. These are the equivalents of exactly similar tubercles described by Agassiz in *Cydippe*, but not noticed by him in his description of *Idyia*.

Development.

In his account of the development of *Beröe*, the author described the ovum, after its escape from the surrounding water, as consisting of a spherical vitellus, surrounded by an external transparent and structureless shell, which is separated by a wide interval from the vitellus, the whole being at this time generally surrounded by an atmosphere of spermatozoa, which are in the form of very minute caudate corpuscles.

No trace of germinal vesicle or spot could be detected in the vitellus, which has the appearance of being composed of minute cells, and whose peripheral portion is differentiated as a somewhat denser layer. A few hours after the escape of the ovum segmentation begins, and this process goes on until the vitellus is broken up into numerous very distinct and quite free spherules, each of which is plainly a cell filled with a multitude of similar cells. The segmenting process, however, has not been going on uniformly in all the divisions, and these resulting spherules are consequently of unequal size, and represent different stages in the process. Next, successive segmentations go on with great activity in some of the spherules, while others continue unaffected by it, or present it with much less energy, and the former become broken up into a multitude of cells, by which the latter are gradually enveloped; so that the ovum now presents two very distinct portions—a central one composed of large spherical cells, and a peripheral one of much smaller cells.

Simultaneously with the completion of the peripheral layer, a large lacuna is formed among the cells in the centre of the ovum. A depression—the future mouth—next takes place upon the surface of the embryo; and this becomes deeper and deeper, until it reaches the central lacuna, into which it finally opens. At the same time, the ocelliform body, with its capsule, and the rudiments of the tentacular discs, become apparent. The refractile corpuscles of which the ocelliform body is composed, may at this time be plainly seen to be developed in the interior of delicate spherical cells. The eight meridional bands have also by this time made their appearance, and may be seen in four pairs extending from within a short distance of the ocellus, along the sides of the embryo to about one-fourth of the whole distance from the ocellus to the mouth.

The next stage observed is the differentiation of a portion of the large-celled tissue which constitutes the principal substance of the embryo, into two somewhat piriform masses, extending one on either side of the alimentary cavity, and which, simultaneously with their formation, become excavated by an extension of the large central lacuna. They thus form two large sacs appended to the central lacuna, and opening into it, and are to become the deep longitudinal gastro-vascular canals.

Nearly at the same time, two other exactly similar masses, and also containing an extension of the central lacuna, are found opposite to one another, on the two remaining sides of the alimentary cavity, so that this cavity is now surrounded by four sacs.

The two last-formed sacs now become divided, each into two, and the divisions thus produced become more and more widely separated from one another, and become superficial to the first formed sacs. We now find them in contact with the peripheral layer of the embryo, where each sac corresponds to the space occupied by a pair of meridional bands and the interval between them.

Lastly, These four sacs begin to divide, each into two, from the peripheral towards the central side, leaving one half adhering by its peripheral side to each meridional band, so that every band has now a sac to itself, and the subsequent conversion of these sacs into the eight meridional canals is easily understood.

About the same time the central lacuna has sent off its two branches, which are to open by external orifices at each side of the ocelliform body; but the author had not succeeded in satisfactorily tracing the formation of these branches.

Hitherto the embryo was confined within the shell, but in the next stage described, the young *Beröe* was free. It was about one-eighth of an inch in length; the meridional bands had extended to somewhat more than half the distance between the ocellus and the mouth. The mouth was surrounded by the circular canal, and the two deep gastro-vascular canals had opened into the latter. The circular canal probably originates in lateral branches from the distal extremity of the deep gastro-vascular canal; but the author failed in satisfactorily tracing its mode of development. Four out of the eight superficial gastro-vascular or ctenophoral canals, namely those which corresponded to the narrow sides of the digestive cavity, had also opened into the circular canal; but the other four meridional canals, though extending for some distance beyond the oral extremities of the meridional bands, had not yet opened into it, and terminated towards the mouth, each in a blind extremity. The eight meridional canals had begun to send out their cæcal offsets; but these were as yet few in number, and simple. Individuals of about three-fourths of an inch in length had all the gastro-vascular canals in communication with the circular canal. The cæca had become numerous and ramified, and the capillary tubes appeared fully developed. The meridional bands, however, had not yet attained their full extent, their oral termination being still separated from the mouth by a distance equal to about one-third of the entire meridional length of the animal; while the generative organs had not yet made their appearance, and the processes of the tentacular discs were nearly simple.

3. On the Anatomy and Classification of the Heteropoda. By John Denis Macdonald, Esq., R.N., F.R.S., Surgeon of H.M.S. "Icarus." Communicated by Dr Douglas Maclagan.

The author considers the usual division of the Heteropoda into the two families of Firolidæ, and Atlantidæ as unsatisfactory, and arranges them in three families, according to the following zoological characters.

HETEROPODA.

I. GYMNOSOMATA (*Firolidæ*). Animal wholly naked or without a shell.
  1. With slender tentacula, and destitute of true branchiæ. Visceral mass near the root of the filiform process of the Metapodium—*Firoloides*.
  2. With rudimentary or no tentacula, but furnished with true branchiæ. Visceral mass considerably in advance of the base of the filiform process of the Metapodium—*Firola*.

II. THECOSOMATA INOPERCULATA (*Carinaridæ*). Animal in great part naked, but having the visceral mass protected by a shell.
  1. Shell corneous, with an involute nucleus. Swimming-plate nearly opposite the visceral mass. Metapodium with filiform appendage—*Cardiapoda*.
  2. Shell calcareous with spiral nucleus. Swimming-plate considerably in advance of the visceral mass. Metapodium laterally compressed without filiform appendage—*Carinaria*.

III. Thecosomata operculata (*Atlantidæ.*)

1. Shell corneous with an involute nucleus. Operculum subtrigonal, with small lateral subapical nucleus—*Oxygyrus.*
2. Shell calcareous with a spiral nucleus. Operculum oval, with a large median subapical nucleus—*Atlanta.*

After describing the several characters of the order as regards external configuration, eyes, and auditory sacs, the author called attention to the rachidian teeth as being capable of furnishing good generic characters, for which they are especially valuable, as they often outlive the decay of the soft parts.

To avoid undue extension of his paper, the author selected for special description the genera Firoloides and Atlanta, which occupy, according to his views, the two extremes of the group; and he described in detail, and illustrated by coloured drawings, the anatomy of a species of Firoloides which he had met with in Bass's Strait, and the anatomy of Atlanta, with reference to all the species of the genus, adding to these some observations on the other genera, and deferring questions of specific determination to a future paper.

4. On the Structure of *Chondracanthus Lophii;* with Observations on its Larval Form. By William Turner, M.B., and H. S. Wilson, M.D., Demonstrators of Anatomy.

The authors, after a brief historical introduction, proceeded to give a detailed account of the anatomy of this parasitic crustacean, the description comprising that of the female and male, and, so far as they had been enabled to trace it, of the larva also.

Female.—Average length, $\frac{1}{2}$ inch; breadth, $\frac{1}{5}$th inch—divided into cephalic, thoracic, and abdominal portions. Cephalic part presented on each side a lateral process; at the anterior margin a pair of antennæ; and on the ventral aspect a pair of hook organs and three pairs of foot-jaws. The antennæ were segmented, the terminal segments being provided with hairs. Each hook organ consisted of a basal segment and a terminal hook; the former of which was supported on a well-marked triangular frame, on which it was moved by the action of powerful muscles. The foot jaws, attached a little on one side of the mesial line, consisted of three pairs. The first and second foot-jaws consisted each of two segments. The terminal segment in the first foot-jaw was formed of two chitinic plates, connected by their anterior margins, but separated at their posterior margins, which were armed with teeth. The corresponding segment in the second foot-jaw consisted of but a single plate, toothed along its posterior margin. The third foot-jaw had three segments, the terminal one being destitute of teeth.

The cephalic was separated from the thoracic part by a constricted neck.

The thoracic part was characterised by its processes, seven dorsal, two ventral, and five lateral, the cavities within which communicated with the general cavity of the thorax. Its division into four segments was indicated by constrictions. The first and second segments bore each a pair of feet on their ventral aspects.

The abdominal part, very small, was divided into two segments, the anterior of which presented a pair of nipple-like projections, to one of which the male was attached. Of these the authors gave a minute description. Two genital orifices opened, one on each side of this segment. From each orifice a long string of ova, spirally twisted, depended. The ovaries consisted of a branched system of tubes, occupying the cavity of the thorax, and extending into the processes and feet. Each ovary communicated close to the genital orifice with the cement organ. The alimentary canal, axially situated, commenced at the oral aperture, which was situated immediately in front of the first pair of foot-jaws. It reached almost as far as the thoracic end of the animal. It possessed lateral dilatations, but no anus.

MALE, very minute, $\frac{1}{20}$th of an inch in length, pyriform in shape. Divided into cephalic, thoracic, and abdominal parts—cephalic end broadest and largest; furnished with antennæ, hook organs, and foot-jaws. By its hook organs it was attached to one of the nipple-like projections on the body of the female, on which it was parasitic. Hook organs and foot-jaws resembling in miniature those of the female. Thoracic part distinctly divided into four segments, the two anterior bearing each a pair of feet. No dorsal, ventral, or lateral processes. Abdominal part divided into two segments, in the proximal of which the two male genital orifices were situated. Alimentary canal in the axis of the animal, with a mouth situated as in the female, but no anus. Testicles bilateral.

Various stages in the development of the ovum, as far as the formation of a free larva, were then described; but the further stages, up to the fully developed animal, the author had no opportunity of tracing.

Monday, 3d February 1862.—DR CHRISTISON, V.P., in the Chair.

The following Communications were read:—

1. Investigation of an Expression for the Mean Temperature of a Stratum of Soil, in terms of the time of year. By J. D. Everett, M.A., Prof. of Mathematics, &c. in King's College, Windsor, Nova Scotia. Communicated by Prof. Tait.

In vol. xxii. of the Transactions of the Society, Prof. W. Thomson has given (after Fourier) the general solution of the problem of underground conduction, and he and Professor Everett have given methods more or less accurate of determining from observation the specific constants for any locality. These are mainly applied to the results of Principal Forbes's observations on the Calton Hill and other places near Edinburgh. (*Trans.*, vol. xvi.)

The present paper has for its object the calculation of the mean temperature of a given stratum of soil at any given time. If v be the temperature at time t, at depth x, v is known by the paper first referred to, in terms of x and t—and the object of the present paper is the easy approximate calculation of the value of the quantity $\frac{\int v dx}{\int dx}$ between any limits of depth x. The method is applied to the Calton Hill observations.

2. Notice of the Catadioptric Altitude and Azimuth Circle.

By Edward Sang, Esq.*

This little instrument differs from the ordinary theodolite in the means by which the direction of the object under examination is indicated.

The simplest contrivance for marking the direction of a distant object is a straight rod. This, with the very obvious improvement of studs at the ends, was the only instrument available to the ancients for astronomical observations; it is yet employed in gunnery, and even by surveyors in the plain-table and cross-staff.

The objection to the plain-sight, when it is to be applied to accurate purposes, is that the eye cannot be adapted to distinct vision for three different distances at the same time. We cannot see the notch, the *visé*, and the object aimed at, all distinctly.

The invention of the telescope effected a complete change in the apparatus for the precise measurement of angles. By it the arrangement of the plain-sight was reversed; the eye-hole was expanded to admit the object-glass, and the image was received at the plane of the cross-wires.

These two are the only improvements which have hitherto been made in the art of pointing. Hadley's quadrant, the invention of which has almost created nautical astronomy, is a contrivance for indicating the difference between the directions of two objects; it does not show the direction of either.

The pointer used in the catadioptric theodolite is thus the third of its class; it contains, literally within the compass of a nut-shell, the means of determining the direction of an object true to within half a minute of a degree.

About the years 1815, 1816, the late Rev. Edward Irving gave to his class of young geometers as an exercise, "To construct graduated squares with plummets attached, by help of which the tangents of angles of elevation may be observed." Some of us used pasteboard, some wood; and it happened that, having broken my school slate, which was a thick one, the idea came into my head to make my square out of the larger fragment. Armed with these little instruments, we attacked and carried most of the surrounding heights. The weather-cock on the top of the church steeple was, as a matter of course, one of our targets. On bringing the upper edge of my slate-square to bear upon it, that upper edge having been ground flat and pretty well smoothed, I saw the inverted image of the weather-cock. It then occurred to me that, if I could bring the image to agree with the weather-cock itself, the plane of the upper edge would be accurately pointed. At the same time it was obvious that when the plane passed through the object there could be no reflection.

Here, then, was a problem "To obtain a reflection such that the reflected can be collated with the direct image, and afford a test of accurate pointing." The pointer used in the catadioptric theodolite exhibits a complete solution of this problem. It is a piece of glass cut in the form of an isosceles tetrahedron, of which two faces form an edge of about 90°, the other two an edge of about 120°, the one pair being set symmetrically upon the other. This pointer has been patented. On turning it towards any object, and looking into the glass, we perceive an inverted image of the object, and on bringing the eye to look past the edge of the glass, as when using the *camera lucida*, we see the object also; and so can collate the image with the object.

By means of the motions in altitude and azimuth we can cause the image to agree with the object, and are then certain that the line of direction passes through the object.

I do not wish to occupy the time of the Society with a disquisition on the theory of the pointer, but rather to indicate the peculiar facilities which it gives for astronomical and geodetical operations in which a precision to half a minute is sufficient. The instrument is inapplicable whenever greater nicety than this is requisite.

When we point the telescope of a common surveying theodolite to a star, we find that the cross-wires have disappeared in the darkness, and that it is necessary to render the wires visible by making an artificial twilight within the tube. To hold the lamp for this purpose is so troublesome, unless—as in the case of large instruments—a special arrangement be made, that very few surveyors indeed ever use their theodolites for sidereal observations.

But, by using the crystal pointer, the star itself is made the point of reference, and the illuminating apparatus is unneeded.

If we bring the catadioptric theodolite into such a position as to cause the image of a star to agree with the star seen directly, and leave the instrument untouched, the two bright points are seen slowly to separate; while the star moves forward in its diurnal circuit the image moves with the same velocity backwards, the rate of separation is doubled, and the line joining the two points indicates the direction of the motion. In this way it is easy to determine whether the star be ascending or descending, or to judge of its being at its greatest or least altitude. Thus the determination of the latitude from the meridian altitude of a star is very easy; that of the sidereal time is not less so.

We have to note the exact instant at which some star, not far from the prime vertical, has a known altitude. For this purpose we turn the pointer a little in advance of the star, and bring the image to be very nearly above or below the star, according as the observation is made on the east or on the west side of the meridian. Then, counting the beats of the chronometer, we watch until the line joining the two become horizontal, and thus obtain the instant at which the star had the elevation shown on the altitude circle.

It is better, when making this observation for time alone, to let the image pass at a little distance—say two or three minutes—from the star, than to attempt to make them coincide, because the eye can very readily judge of the horizontality of the line joining the two luminous points. But the altitude azimuth and time can all be obtained at once in the following way:—

Having brought about the coincidence, we watch for one or two minutes, and estimate carefully the direction of the separation, then, by help of the tangent-screws, we cause the image and the star to exchange places, as it were, keeping the same inclination, and leaving the instrument untouched, we count the beats of the chronometer until the coincidence take place. In this way we obtain the time and the simultaneous readings on the altitude and azimuth circles; from these the longitude and the direction of the meridian can be computed.

The direction of the meridian is very readily obtained from the greatest easting or westing of a star which passes between the pole and the zenith, particularly in low latitudes. The manner of proceeding with the crystal pointer is to make the coincidence, to wait a little and observe the direction of separation; when this direction is vertical the star is at its greatest azimuth.

Lastly, the latitude of the place may be corrected by observing the two transits of a star over the prime vertical near to the zenith; the operation is exactly analogous to those already described.

When the horizontal axis is made perpendicular to the meridian the instrument can be used as a transit. The instant of the sun's passage can be found by observing the contact of the first limb, then the entire coincidence, and lastly, the contact of the second limb. The average of these three may, in general, be depended upon to within two seconds of time; while, by observing the moon's meridian passage, and comparing it with those of two stars, the Greenwich time may be obtained to within one minute from a single set of observations.

The lightness and portability of the instrument, and its adaptation to near or distant objects, promise to bring the practice of geodetical astronomy within the reach of many who have been hindered from the prosecution of this branch of science by the bulk and expensiveness of the instruments required.

3. On the Nesting Birds of Linlithgowshire and Berwickshire. By the Rev. John Duns, F.R.S.E., Torphichen.

In April 1860, I brought under the notice of the Society a classified list of the Birds of Linlithgowshire. The list was accompanied with notes, "On the Structure and Habits of some of the Rarer Species." After the publication of the Society's Proceedings, several communications were addressed to me by well-known ornithologists, chiefly with the view of ascertaining, if some of the rarer species named had been known to nest in the district. This led to the revision of the list, and to the exclusion of such species as are either rare visitors only, or winter birds of passage. A List of the Birds of Berwickshire, drawn up on the same plan, is now associated with this.

Were similar lists to be drawn up by observers in other counties, the true native birds of Scotland would be better known than they are at present. In most works on British Ornithology they are classed with stragglers from almost every clime.

Several influences are at work, which may soon come to diminish the numbers of our native nesting-birds, and which have already reduced them in certain districts. In the Lowlands, there are now large tracts of country, in which game is not protected, and in which laws of trespass are never enforced. It is thus easy for any youth to carry a gun in quarters in which, a few years ago, he would have been closely watched. The rarer birds suffer; they are intruded on in their favourite haunts, and either scared from them at the breeding season, or wantonly destroyed. The black grouse, which used to breed regularly in Linlithgowshire, is now seldom seen, and the red grouse is now confined to a heath-clad tract, of a few hundred acres, which is being fast broken in upon by mining operations. In the course of four or five years, both species will cease to be reckoned as nesting-birds in the county. The king-fisher, the ring-ousel, the redstart, the gold-crest wren, the bullfinch and goldfinch, have so greatly diminished within a few years, that they are now comparatively rare.

The strict preservation of game has had an influence in another direction. War is waged against every bird believed to be hurtful to the eggs or to the young of the pheasant, partridge, and grouse. The kite has disappeared from the middle and south of Scotland. In Berwickshire, the hen harrier is now rare; and in Linlithgowshire it appears at long intervals as a straggler only. The merlin will soon cease to be met with in both counties. The sparrow-hawk is fast disappearing; and even the kestrel—the farmer's friend against field mice, and several beetles, whose larvæ are most hurtful to his wheat crops—is ignorantly shot down as a plunderer, though entirely innocent touching game. In comparatively recent times, the raven used to nest in Linlithgowshire. It is now never seen. In Berwickshire, it is rare. In Linlithgowshire, the jay is seldom met with, and even the magpie is not able to cope in cunning with the gamekeeper.

Agricultural improvements are also beginning to tell unfavourably on some of our native birds. If the alternative were,—" You must either lose the green and corn crops, or destroy the birds," I suppose even the most enthusiastic naturalist would choose the latter. But it should be the chief aim of the agriculturist to keep the birds alongside of his improvements. Since by drainage, he has banished the wild duck, the curlew, and the snipe, from localities in which they used to abound, he would find it profitable to set apart a spot specially for them. And if he must have stone walls and wire fences, in order to get quit of weeds and to save his crops from insects which find shelter during winter in the hedgerows, he would never regret having left a bush here and there for the birds to build in. If this be not done, he will assuredly find in the turnip-beetles and saw-flies, in the corn-midges and wire-worms —the larvæ of weevils and elaters—" a great people and strong," enemies, any thousand of which will do more harm to his crops than all the birds of the air would.

In the following list the birds of Linlithgowshire are referred to on the left hand of the column. Those of Berwickshire are characterised on the right hand.

The letter R denotes *Regular*, or birds which breed constantly in the districts; H denotes *Historical*, or birds which used to breed in the localities, but which have for many years ceased to do so; O denotes *Occasional*, or birds which have been known to breed at long intervals in the districts; and O, B refers to such as have been seen occasionally at the breeding season, but whose nests have not been discovered.

Linlithgowshire.		Berwickshire.
O.	Falco æsalon.	O.
R.	F. tinnunculus.	R.
R.	Accipiter nisus.	R.
H.	Circus cyaneus.	R.
R.	Strix flammea.	R.
R.	S. aluco.	R.
R.	S. otus.	R.
R.	Cuculus canorus.	R.
R.	Caprimulgus Europæus.	R.
R.	Hirundo rustica.	R.
R.	H. urbica.	R.
R.	Hirundo riparia.	R.
R.	Cypselus murarius.	R.
O.	Alcedo ispida.	R.
R.	Certhia familiaris.	R.
R.	Troglodytes Europæus.	R.
R.	Turdus merula.	R.
O.	T. torquatus.	R.
R.	T. viscivorus.	R.
R.	T. musicus.	R.
R.	Cinclus Europæus.	R.
O.B.	Lanius excubitor.	

Linlithgowshire.		Berwickshire.
	Lanius collurio.	O. B.
R.	Sylvia rubecula.	R.
R.	S. hortensis.	R.
	S. atricapilla.	O.
R.	S. cinerea.	R.
R.	S. phœnicurus.	R.
O.	S. locustella.	
O.	S. arundinacea.	O.
O.	Phyllopneuste sylvicola.	R.
R.	Ph. trochilus.	R.
O.	Ph. hippolais.	R.
R.	Regulus auricapillus.	R.
R.	Saxicola œnanthe.	R.
R.	S. rubetra.	R.
R.	S. rubicola.	R.
R.	Accentor modularis.	R.
R.	Parus cæruleus.	R.
R.	P. major.	R.
R.	P. longecaudatus.	R.
R.	P. ater.	R.
R.	Motacilla Yarrelli.	R.
R.	M. boarula.	R.
R.	M. flava(*Budytes.*)	R.
R.	Muscicapa grisola.	R.
O.	M. luctuosa.	
H.	Corvus corax.	O.
O.	C. corone.	R.
R.	C. cornix.	R.
R.	C. frugilegus.	R.
R.	C. monedula.	R.
R.	Garrulus melanoleuca.	R.
R.	G. glandarius.	R.
R.	Sturnus vulgaris.	R.
R.	Pyrgita domestica.	R.
R.	Fringilla cælebs.	R.
O.	F. spinus.	
R.	F. carduelis.	R.
R.	F. cannabina.	R.
O.	F. linaria.	R.
	F. flavirostris.	O.
R.	Loxia chloris.	R.
R.	L. pyrrhula.	R.
O.	L. Europæa.	
R.	Emberiza citrinella.	R.
O.	E. miliaria.	R.
R.	E. shœniculus	R.
R.	Alauda arvensis.	R.
R.	Anthus pratensis.	R.
	A. obscurus.	R.
O.	A. arboreus.	O.

Linlithgowshire.		Berwickshire.
R.	Columba palumbus.	R.
	C. livia.	R.
O.	Tetrao Scoticus.	R.
O.	T. tetrix.	R.
R.	Perdix cinerea.	R.
O.	P. coturnix.	
R.	Phasianus colchicus.	R.
R.	Ardea cinerea.	R.
H.	Botaurus stellaris.	
R.	Charadrius hiaticula.	R.
R.	Pluvialis aurea.	R.
	P. morinellus.	O. B.
	Hæmatopus ostralogus.	R.
O.B.	Scolopax rusticola.	
R.	S. gallinago.	R.
O.B.	S. gallinula.	
R.	Numenius arquata.	R.
R.	Totanus hypoleucus.	R.
	T. calidris.	R.
O.	Tringa variabilis.	R.
O.	Rallus aquaticus.	R.
R.	Crex pratensis.	R.
R.	Gallinula chloropus.	R.
R.	Fulica atra.	R.
R.	Cygnus mansuetus.	R.
R.	Anas domesticus.	R.
R.	A. boschas.	R.
O.B.	A. crecca.	O.
	Anas tadorna.	O.
O.	Podiceps minor.	R.
	Uria troile.	R.
	U. grylle.	R.
	Alca torda.	R.
	A. artica.	R.
	Pelecanus carbo.	R.
	P. graculus.	R.
	P. bassanus.	O.
	Puffinus anglorum.	O.
	Procellaria pelagica.	O.
	Larus rissa.	R.
	L. marinus.	O.
	L. fuscus.	O.
	L. argentatus.	R.
	L. canus.	R.
	L. ridibundus.	R.
	Sterna cantiaca.	R.
O.	S. hirundo.	R.
	S. artica.	R.
	S. minuta.	R.
	S. Dougalii.	O.

A pair of the grey shrikes named in the list, frequented some old thorn trees, near Torphichen village, during the end of May and beginning of June 1846.

The red-backed shrikes were observed by me in July 1859, at Oxendean, near Dunse Castle, Berwickshire. This, I believe, was the first time they have been seen in Scotland. The red-backed shrike passes the winter in Africa, and visits England in May. "It breeds," says Fleming, "in the southern counties of England." "It is," says the late Bishop of Norwich, "generally speaking, very rare in most parts, confining itself to Essex, the Sussex Downs, Wiltshire, and Gloucestershire." Mr Selby has not traced it farther north than Cumberland. M. E. T. Bennet, in one of his notes to White's Selborne, refers to this bird as one which belongs to the south of England, and is scarcely ever met with in the north. In 1840, Mr M'Gillivray recorded that "it had not hitherto been observed in Scotland."

4. Note on Molecular Arrangement in Crystals. By Professor Tait.

To illustrate my lectures on Molecular Forces, I sometimes use piles of marbles of equal size. Each of these is taken to represent the *sphere of action* of a symmetrical integrant molecule, in the sense that the attractive and repulsive forces necessary to a theory of molecules are balanced, when the distance of two molecules is equal to the diameter of the sphere. If the integrant molecules be not symmetrical, their *spheres of action* will be spheroids or ellipsoids.

In arranging such piles, there are two obvious ways of constructing the layers, and two of applying layer to layer.

Thus, a horizontal layer (suppose) may be arranged in *square*, or in *triangular* order; and successive layers may be *simply superposed* or *inserted into interstices* in the preceding ones.

By this it would appear, at first sight, that arrangements of four different densities are producible. Such, however, is not the case. The very obvious results which I intend now to give, must have occurred long ago to others, but I have found no such record; and their apparent novelty to scientific friends to whom I have mentioned them, must be my excuse for occupying the time of the Society with so trifling a matter.

The density of a mass, or the number of marbles per cubic mile (say) is easily seen to be proportional inversely to the product of the distances of the centres of contiguous ones, taken parallel to any three rectangular lines.

Hence

(1.) When layers in square order are superposed, a being the radius of a molecule—

$$\text{Density} \propto \frac{1}{2a \times 2a \times 2a} \propto \frac{1}{8a^3}$$

(2.) Layers in triangular order superposed—

$$\text{Density} \propto \frac{1}{2a \times 2a \times \sqrt{3}a} \propto \frac{1}{4\sqrt{3}a^3}.$$

(3.) Layers in square order, interstices occupied by molecules of next layer—

$$\text{Density} \propto \frac{1}{2a \times 2a \times \sqrt{2}a} \propto \frac{1}{4\sqrt{2}a^3}.$$

(4.) Layers in triangular order, interstices as before,—

$$\text{Density} \propto \frac{1}{2a \times \sqrt{3}a \times \frac{2\sqrt{2}a}{\sqrt{3}}} \propto \frac{1}{4\sqrt{2}a^3}.$$

These densities are (1.) : (2.) : (3.) : (4.) : : $\frac{1}{\sqrt{2}} : \sqrt{\frac{2}{3}} : 1 : 1$; or, ·707 : ·816 : 1 : 1, and may be sought for in various forms of the same body.

Hence, the density in arrangements (3) and (4) is the *same.* It is worthy of note, that the simplest crystalline form which is derivable from (3), is the octahedron of the first system, and that from (4), is its *hemihedral* form, the regular tetrahedron.

By inspecting the piles of marbles for the two cases, it is easy to see without analysis, that the densities are equal. This is best seen by removing an *edge* of the tetrahedral pile.

I have tried to connect these results with allotropic forms of bodies which crystallize in the first system (and an easy modification allows us to pass to other systems)—but though diamond and graphite *seem* to agree so far with it—it must be taken at present as a pure speculation.

Royal Physical Society.

Wednesday, 22d January.—James M'Bain, M.D., R.N., President, in the Chair.

The following Communications were read:—

1. *Notes on the Habits of the Beaver.* By an Eye-witness, James M'Kenzie, Esq., an Officer in the Hudson's Bay Company Service.

The Beaver is found over a wide extent of country on the American continent, extending east and west from the Atlantic to the Pacific, and probably from Lat. 48° to 54° north; but on the slopes of the Rocky Mountains, where the climate is comparatively mild, he is met with much further north and south. My object, however, is not so much to define his geographical limits, as to make a few notes on his habits. Beavers build occasionally on the shores of lakes, but prefer the banks of rivers and streams. They go generally in pairs; and having selected a convenient site near the banks of the river, the two clear a circular piece of ground, generally 6 feet in diameter, carefully removing everything on the surface. This done, they carry in their *arms*, walking on the hind feet, 5 to 10 lbs. of strong clay from the river, and deposit it to a width of 2 feet all round the circle, thus making the diameter 4 feet; then collecting long grass or branches of willow, they mix up the whole well together, so as to form a good foundation. In this way they build the walls to a height of about 10 feet, gradually narrowing; and the whole has a rounded form, somewhat like an oven. Unless they had some means of plastering or smoothing down the mud walls, the rain would certainly wear them away in a short time; and although it is supposed that the beaver never uses his tail as a trowel, I have it from the authority of eye-witnesses that he does so—in fact, Nature has furnished the animal with the tool ready made to his hand. After he has laid the foundation, and, indeed, in process of laying it, before the clay gets dry, he uses the trowel; and when the wall is raised to a certain height, he goes round the circle, carefully plastering every load he carries from the river and lays on his house. The lodge has neither doors nor windows, and the finishing hand is not put to it till he is far advanced with his bridge, or perhaps until he has completed it. Before the house can be completed, a subterranean passage is excavated from its centre to the dam or pond, and this at a depth varying from 2 to 6 feet, depending on the difference of level between the river and house. He then strews his floor with thin strips of willow tree, cut by him in the form of carpenter's shavings, for his winter's bed. The construction of the bridge shows even more ingenuity than the construction of the house, and is of various lengths, depending on the size of the stream. When only a few feet wide, the wall goes straight from bank to bank at right angles to the current; when larger, or about 40 feet wide, it is formed of a single curve; but when the river to be bridged is from 100 to 120 feet wide, the wall is formed into a series of curves, or undulations as it were. He understands pretty well the properties of straight and curved lines in his engineering works, and knows the mode best suited to the circumstances in which he is placed. If his domicile is situated on a wide stream, he adopts that mode of construction which is best adapted to withstand the pressure of a great body of water and ice on the opening of the navigation in the spring. The wall is about 12 feet high and 9 feet wide at bottom, but on the side exposed to the current it slopes with the stream, forming, perhaps, an angle of about 40°. At any rate, while the wall is about 9 feet wide at bottom, it is only 1 foot wide at top. He selects for the foundation pieces or logs of timber which are water-soaked; but if he cannot find enough of these, any wood, either green or dry, will do, covering them with large stones, to prevent their rising to the surface. But logs thus placed on one another across a stream could not be so well fitted together as to prevent the passage of the water between them. To meet this difficulty, he plasters the side of the wall exposed to the current with a coating of clay some 2 or 3 inches in thickness; and this clay, as he has to travel through the water with it, he carries not in his arms, as in the construction of the house, but on his *head*, supported by his arms. There is no doubt that the side of the wall exposed to the current is thus clayed, although I cannot well understand how it could withstand the action of the water for any length of time. If he bridged the stream in this way and clayed his bridge, it is clear that he would have always a large quantity of water flowing over the top, which would impede his operations; and, to obviate this difficulty, he leaves an opening at either end for the passage of the water, to be shut up afterwards. Having finished the wall, the next thing to be done is to collect his winter's supply of food. This consists of the bark of the ash. the bark and leaves of a certain kind of poplar, the bark and leaves of some kind of willows, and the fruit of the alder. A large poplar tree of about a foot in diameter, two beavers can cut down in half an hour's time. It is afterwards cut into lengths of about 5 feet; and when he has got enough, he makes a road to the stream from 3 to 6 feet wide, by cutting down trees or shrubs which may be in his way. If the road be inclined towards the stream, he rolls the wood down before him; but if it be level, or nearly so, he takes hold of the wood by his teeth, and carries it forward. In the water he always transports wood or branches from one spot to another in a similar manner. His wood will, of course, float in the water, and, if left to float, would soon become embedded in the ice, which in ordinary winters, in this climate, is about 5 feet in thickness; he therefore takes it to the bottom of the dam, which has a depth of water of from 10 to 12 feet, and either fastens it on end in the mud, or covers it with stones, to prevent its rising, and it will thus at all times be available for his purpose. He is now nearly ready for the long winter. There is, however, something more to be done. I have mentioned that he digs a subterranean passage from his house to his dam; on each side of this, and in some instances widely apart, he makes holes about 5 or 6 feet in the bank, generally communicating in the interior with one another, and with the main entrance to the lodge. In one of these he takes his food, for he seldom or never eats where he sleeps.

The female has generally from three to six young at one time; the period of gestation is four months; and the young are produced, or first see the light, about the middle of May, and in the following August assist in building the lodge. The young and old work together. When about a year old, they start in pairs to form new settlements, provided, like the best of colonists for a new country, with nothing else but good strong limbs and a fine set of teeth. If there be an odd-fellow, he goes on his travels alone, and forms a small bachelor establishment for himself for the winter, unless, indeed, he meets a friend with kindred sentiments by the way. Sometimes two of the year-olds remain in the old house for another year, in which case the family in the following May is a large one, never, however, numbering more than twelve individuals. The usual number found in a lodge is from four to eight. They never build their lodges close together—they are generally from a quarter to half a mile apart. This no doubt arises from the circumstances that they cannot well dam the rivers or streams, and find a sufficiency of food, at shorter distances. The beaver remains shut up for the whole winter; during the day always asleep, and during the night taking his bath and his meals. In spring, however, he sometimes makes a hole in the ice to have a look at the country around him. I do not know how he manages to do without air; so far as I could discover, there are no air-holes about his premises. In the coldest weather, the top or roof of the lodge is always moist or wet, while the sides are frozen, at least outwardly. It is certain that he can remain under the water for half an hour at a time. He lives in the same lodge for two or four years, when, finding his food scarce, he removes to another locality and builds as before.

For instinct or intelligence he is at the head of the wild animals in this country, and lives longer, I believe, than any of them. Other animals, as for instance the young of the American hair or rabbit, the marten and lynx, perish by thousands in the spring, either by cold, or in seasons of high water, or from lack of their ordinary food; but it is all the same to the beaver whether the season be wet or dry, hot or cold—the shores of every lake and the banks of every river furnish him with abundance of food.

I do not know whether he will thrive in Britain; at any rate, the Zoological Gardens is not the best place for him; he is fond of solitude, and does not like company. An island with a large lake would be the most eligible place for him, where, if set at large, he would soon shift for himself. Of course his usual food would require to be found on the spot.

Dr J. A. Smith said, with regard to Mr M'Kenzie's statement that he could discover no air-holes in the lodges of the beaver, and wondered how they managed to do without air; it was probable the air got access through the comparatively looser structure of the top of the lodge, which Mr M'Kenzie states is always moist or wet even in the coldest weather, while the sides are frozen outwardly.

2. *On an apparently New Form of* Holothuria. By John Anderson, M.D.

In the autumn of 1859 I dredged from five fathoms water in Bressay Sound, Shetland, the Holothuria which forms the subject of this memoir. The dorsal region of the body, when the creature is contracted, is a deep purplish brown tint, but the central surface is of a paler hue. When contracted, it is little more than a quarter of an inch in length, and about the fifth of an inch in breadth; but when distended and moving about, it becomes double this length, and its breadth also is slightly increased. The five double rows of sucking feet are unsymmetrical, the two dorsal rows being irregular in their distribution. The dorsal feet are less numerous than the ventral, which they greatly exceed in size, and from which they differ very much in their undilated tips, and by their being seated, in some instances, upon rounded eminences or tubercles. Though the two dorsal rows of feet differ very much from the ordinary arrangement of these organs in the Holothuriadæ, yet we can trace faint indications of the double character of the rows. The three double rows of ventral sucking-feet are fully developed; the feet are placed opposite to one another, and are dilated at their tips, but are only partially retractile. The animal walks upon three well developed rows, and if turned upon the aborted ones, it immediately recovers itself, and turns round to what appears to be its ventral surface. The tentacles are ten in number,—eight of them are long, pedunculated, and alternately branched, and the other two are short, and divided at their tips. They are all of a pale yellow colour, very pellucid, and are about a fifth of the length of the body when it is fully extended. The two short tentacles correspond to the two tuberculated rows of feet of the dorsal aspect. The body of the animal is covered with calcareous plates of an irregular form, and perforated by nearly circular holes. The plates found in the feet of the three central rows are spindle-shaped, but they change their form in the feet immediately surrounding the head, and become in appearance very similar to the plates found on the body-skin. The plates of the dorsal tubercles and feet resemble, in their irregularity, the plates of the body of the animal; and the same may be said of the plates found in the tentacles, in which they may be found extended to their ultimate divisions.

3. *Notes on the Ornithology of Caithness.* By R. I. Shearer, Esq., Ulbster House, and H. Osborne, Esq., Wick. Communicated by the Secretary.

Wednesday, 26th February.—John Coldstream, M.D., President, in the chair.

The following communications were read:—

1. *Exhibition of Drawings, by Native Artists, of Animals collected in India, belonging to the different great divisions of the Animal Kingdom.* By Walter Elliot of Wolfelee, Esq. Communicated by John Coldstream, M.D.

2. *Observations on British Zoophytes*,—1. Atractylis arenosa. 2. Atractylis miniata (*new species*). 3. Laomedea ——? (*new species*). By T. Strethill Wright, M.D.

3. *On the Geological Age of the Pagan Monuments of the Outer Hebrides.* By Captain F. W. L. Thomas, R.N.

(This paper appears in the present No. of the Journal.)

4. *Description of several Fishes from Old Calabar.* By John Cleland, M.D., Glasgow. Communicated by William Turner, M.B.

The specimens now exhibited were given me by our late lamented Treasurer, Mr Oliphant, and it was his desire that they should be shown to this Society. They come from Old Calabar. They are not in very good preservation, but are sufficiently so for the determination of their characters. Besides a small specimen of *Chromis niloticus* (Cuv.), there is an *Eleotris* and four fishes of the family *Siluroidei*, none of which correspond with species described in the work of Cuvier and Valenciennes, or such other books as I have been able to consult. They may possibly be mentioned in recent monographs which I have not had an opportunity of seeing.

1. The *Eleotris* presents well the characters of that genus, the head being much depressed, the body slender, the eyes remote, the gape very large for the size of the body, and the lower jaw prolonged beyond the upper, so as to give the mouth an upward direction, which may probably be looked on as convenient to a fish inhabiting the muddy parts of the water, and preying upon animals swimming overhead. Also, it shows well the appendage behind the vent and the ununited ventral fins, which distinguish this genus from *Gobius*. It has no vomerine teeth; its scales are small; its total length to the tip of the caudal fin is five inches. The caudal fin is one inch long and rounded.

The number of the fin rays is as follows:—first dorsal eight, second dorsal ten, caudal thirty-two, anal nine, pectoral sixteen, ventral six.

2. Of the *Siluroid* specimens one is a *Synodontis*, and corresponds exactly with a specimen in the British Museum. I believe that it is the *Synodontis serratus*, although the number of its fin rays agrees rather with that attributed to *S. arabi* in the work of Cuvier and Valenciennes.

The anterior dorsal fin has eight rays, the first of which is, as in all the members of the genus, a long and strong slightly curved spine fixed at right angles to the body. This spine is toothed on its posterior edge, and towards the point anteriorly.

The posterior or fatty dorsal fin, half an inch high and two inches long, is continued further back than the posterior margin of the anal fin. The caudal fin is bifurcated, the superior half longer than the inferior. From the longest ray above to the longest below, inclusive, there are seventeen rays; and outside these there are eleven shorter rays in each half. There are thirteen rays in the anal, nine in the pectoral, and seven in the ventral fin. The first pectoral fin ray in *Synodontis* is a large spine toothed before and behind, the posterior teeth being longest, about equal in length to the dorsal spine. There is no locking arrangement in its joint, and therefore it can only be kept in the extended position by muscular effort. On the other hand we find the lock joint of the pectoral spine in genera in which the dorsal spine is not fixed, as in this genus.

The superior scute of the head passes back nearly as far as the third dorsal fin ray. The coracoid scute is triangular, and passes back as far as the superior scute.

The long curved teeth which hang loosely in the lower lip, and which give character to the genus, are twenty-four in number. Behind them are fine velvety teeth, the patches of opposite sides distinct. In the upper jaw there is a double row of conical teeth, about eighteen on each side, and behind them (on each side) a patch of setose teeth of very irregular size.

There is one superior pair of barbules very long and simple, and two inferior pairs, both of them branched, the outer pair half the length of the superior pair, and the inner pair half the length of the outer.

The specimen is twelve inches long from mouth to tip of tail, and three inches from mouth to the first dorsal spine.

A view of the swimming-bladder of *Synodontis* is given by Müller in his work on Myxinoid fishes.

3. Two of the specimens exhibited belong to the genus *Clarias*, which is characterised by the presence of arborescent branchial appendages attached to the second and fourth branchial arches, and by having only one dorsal fin.

The first of them corresponds exactly to one which I have had the opportunity of examining in the British Museum, and which, therefore, we may expect to have properly described by Dr Gunther in his elaborate work, of which part is already published. The specimen is a foot long. The head is depressed and shielded, oblong in form, the eyes small and lateral; the body is oblong, compressed. The dorsal fin extends from within an inch behind the head back to the tail, but is not continuous with the caudal fin; it contains seventy-six rays, the first of which is not spinous.

The caudal fin contains twenty-four rays, the anal sixty-three, the pectoral twelve, the ventral six. The first ray of the pectoral fin is a spine toothed before and behind, and having a lock-joint, that is to say, its joint is so constructed that when the spine is fully extended it cannot be pushed back towards the body by any direct pressure, but must first be rotated to a certain extent, and then it folds back easily. The anal fin is continued, like the dorsal, back to the caudal, without being continuous with the latter. There is a papilla behind the anus.

The teeth are velvety, in very broad patches. The teeth in the upper jaw are larger than those in the lower; the patch in the lower jaw is broader than that in the upper, and indented at the outer side. On the vomer there is also a broad patch of very minute teeth.

The barbules are eight in number. The anterior superior pair are longest, the external inferior pair slightly longer than the posterior superior pair, while the internal inferior pair are thick, short, and truncated, a character peculiar to this species.

4. The other *Clarias* which I exhibit, resembles two of the Indian species, viz., *Clarias Nieuhoffi* and *Clarias jagur*, in the dorsal and anal fins being continuous with the caudal. It has only one arborescent branchial appendage on each side, which is attached to the fourth branchial arch, and is very small. The specimen is eight inches long to the tip of the caudal fin, the latter being three-fourths of an inch long. The head is depressed, not shielded, three-fourths of an inch long, the body compressed. The barbules are eight, the branchiostegal rays nine. The anterior superior barbules are broadly membranous at the base.

The teeth are velvety, the patch on the lower jaw is much larger than that on the upper, and there is a patch on the vomer.

The dorsal fin begins an inch behind the head; it has no spinous first ray. The rays in it and the anal fin are very numerous. The pectoral fins are small, and have six rays, the anterior ray being a short spine, less than half the length of the succeeding rays, and not lock-jointed. The ventral fins are small and contain three rays.

5. The remaining specimen is a species of *Heterobranchus*. *Heterobranchus* is a genus allied to *Clarias*, having the same sort of arborescent branchial appendages, but having two dorsal fins, the posterior of which is fatty.

The specimen is five and a half inches long, three-fourths of an inch of this length belonging to the caudal fin. The appendages will be seen on the second and fourth branchial arches.

The head is very much depressed, broad, shielded, the eyes lateral, the barbules eight.

The branchiostegal rays are eight. The first dorsal fin has thirty-five rays, the first one not spinous, it ends behind the middle of the body. The fatty dorsal fin extends from the true dorsal to the tail, and contains traces of eighteen very fine rays. The caudal fin has twenty-two rays, it is rounded, and is tipped with black, as are also to a less extent the other fins, and the dorsal aspect of the head is also black. The anal fin has forty-seven rays, and extends from anus to tail. The pectoral fin has ten rays, the anterior ray toothed and lock-jointed, shorter than the succeeding rays. The ventral fin has six rays.

The teeth are velvety, in elongated narrow patches, one of which is on the vomer.

5. *Note on the Omnivorous Character of the Food of the Common Squirrel* (Sciurus vulgaris). By Thomas Durham Weir of Boghead, Esq. Communicated by Dr J. A. Smith.

6. *Ornithological Notes.* By John Alexander Smith, M.D.

The following specimens were exhibited:—

(1.) A pied variety of the blackbird, the head and upper parts of body being variegated with numerous pure white feathers: it was shot near Dundas Castle on the 3d of February.

(2.) A male and female *crossbill*, in fine plumage, killed near Aberdeen on the 13th January.

(3.) *Picus major*, the pied or great spotted woodpecker, an adult male specimen. It was found dead in the shrubbery of T. Durham Weir of Boghead, Esq., Bathgate. It seems not to have been before observed in this county, as it is not included in the list of the birds of Linlithgowshire, by the Rev. John Duns, recently published in the Proceedings of the Royal Society. Mr Small, bird-stuffer, George Street, sent a specimen of a young male, which was shot at Kirkwall, in Orkney, on the 4th of December last; and Mr J. Carfrae, Princes Street, informed Dr Smith that another was killed in Orkney in August last.

(4.) *Hybrid Grouse.* Two male Hybrids, between blackcock and red grouse. They agreed closely with the description given by M'Gillivray in his *British Birds.* They were procured from the Pentland Hills, about twelve miles west of Edinburgh, in the beginning of December last, by Mr Aitken, farmer, Listonshiels.

(5.) A fine specimen of the *Bittern*, which was shot near Balerno on the 24th January. The bird was a male, and its stomach contained a couple of frogs. Another specimen (a female) was shot in Berwickshire between Ayton and Coldingham, in October last.

(6.) A specimen of the *Great-crested Grebe*, shot at Queensferry on the 27th January. Its stomach contained the ball of feathers which is so often found in the grebes. Dr Smith considered it to be simply a 'pellet,' which the bird casts up, as in the hawk, &c.; the feathers assisting to brush out from the stomach the spiny remains of shrimps, &c., which were combined with the mass. A pair of *Sclavonian Grebes*, in their summer plumage, shot by Mr F. Campbell, on the 20th of June 1860, on a loch in his property of Ormsary, Argyle. These birds are not known to breed in Scotland. In this instance they were manifestly rearing a brood of young. *Podiceps auritus*,—the eared grebe,—found by Mr John Blackwood, George Street, in the early part of January, on the sea-beach in the grounds of Lord Rosebery, near Queensferry. It is rarely seen, and is easily known by the peculiarly recurved or bent-up bill, and its small size.

7. A large specimen of the wild cat (*Felis catus ferus*), shot on the property of the Earl of Seaforth, in Inverness-shire, was exhibited by Edward Hargitt, Esq.

8. A fine specimen of *Astrophyton scutatum* * (Linck), (*Asterias caput medusæ*, Lin., Mull., &c. ; *Asterias arborescens*, Pennant), was exhibited by Robert Brown, Esq. It was obtained during an Arctic voyage, undertaken during the year 1861 (Feb. 27 to Oct. 26), in order to study the Natural History of the seas of Spitzbergen and Davis' Straits.

The specimen was taken clinging to a whale-line from 150 to 200 fathoms, muddy bottom, about a mile off Cape Kater, on the west coast of Davis' Strait. He found nothing in its stomach, except a few Diatomaceæ, and a specimen of *Cetochilus arcticus* (Baird, in Appendix to Sutherland's Voyage, vol. ii.), the presence of which might be only accidental. It was loaded with ova of a deep-red colour.

Its occurrence is interesting, as a confirmation of the imperfect record of its being found in Waigat or Disco Fjord on the east coast of Davis' Strait, in the last century, by the celebrated and accurate Otho Fabricius. In his *Fauna Groenlandica*, p. 372 (Hafniæ et Leipsiæ, 1780) he says,—"*Asterias caput medusæ. Hanc in museo plurimum reverendi Dn. Egede de colonia Jacobsharn (ni fallor) missam vidi : unde concludo, in sinu Disco dari : non autem vivam ipse offendi.*"

In 1671, Martin, the surgeon of a Hamburgh whaler, appears to have met with it in his "Voyage to Spitzbergen." Though Captain Phipps (Lord Mulgrave), in his Catalogue of the Animals of the same sea, does not record it. ("Voyage to the North Pole," *apud* Scoresby, "Arctic Regions.")

Sir John Ross, in his Arctic voyage in 1819, obtained a specimen two feet in diameter, which was described by Dr Leach under the synonym of "*Gorgonocephalus arcticus*." It is now in the British Museum.

Bishop Eric Pontoppidan in his "Natural History of Norway," (Part ii. pp. 179, 180. Lond. 1755), gives a very recognisable figure and description of it, as indeed most of the older authors do. That of Professor E. Forbes, among its modern historians, is the only good portrait of it, but from the want of colouring, full justice is not done to the varied beauties of the star-fish.

The coloured figure in Griffith's Cuvier is a mere picture.

Mr Brown gave additional details of its natural history and synonymy.

Owing to the late severe winter of 1860–61, and the ensuing calm summer blocking up the shore with great masses of land ice, he was unable to get into water shallow enough for dredging ; and other circumstances prevented his voyage being successful, in a scientific point of view. He had, however, to thank his friend, Captain George Deuchars of the "Narwhal," for his kind assistance whenever it lay in his power.

---

* The specimen has been deposited in the Natural History Museum, University, Edinburgh.

Botanical Society of Edinburgh.

Thursday, 9th January 1862.—Professor Balfour, V.P., in the Chair.

An address of condolence to the Queen, on account of the death of His Royal Highness the Prince Consort, was adopted, and ordered to be transmitted to Sir George Grey.

The following Communications were read:—

1. *Description of a New Species of Clerodendron, from Old Calabar, Africa.* By Professor Balfour.

(This paper appears in the present number of this Journal.)

2. *Notice of a Diseased Condition of Beeches at Tynninghame, the seat of the Earl of Haddington.* By Professor Balfour.

Professor Balfour stated that he had received a letter from Dr Protheroe Smith, enclosing one from the Earl of Haddington, relative to a peculiar diseased condition of beeches at Tynninghame and Mellerstain. The letters were accompanied by specimens of a cottony matter which had appeared in large quantity on the beech stems. Dr Balfour had written to the Earl of Haddington on the subject, and had received the following reply:—"In regard to the specimens of the 'peculiar substance' which your letter relates to, I certainly am very desirous to know about it. I wish much to know whether it only appears upon trees already in a dying or failing state, or whether it destroys the tree upon which it appears. There can be no doubt that in *every case* where seen the tree dies. It is much more prevalent at Mellerstain than it is here, and very many of the beeches there are condemned. In some cases the whole of the tree is completely covered with the substance, looking at a distance as if it were painted white. In some cases, only one side of the tree is diseased. I have been told that when it once appears in a wood it spreads rapidly; and from what I have seen at Mellerstain, I have too good reason to believe that such is the case." He had submitted the matter for examination to Mr W. R. M'Nab, and to Mr James Hardy, Penmanshiel. Mr Hardy says—"The cottony substance sent is produced by *Coccus fagi*, Walker, List of Homopterous Insects in the British Museum, p. 1086, No. 32, with the specific character, 'yellow, elliptical, covered with white powder; length of the body two lines.' This is the second time it has come under my notice. At first I had it from Mr C. M'Intosh, then of Dalkeith, and gave an account of it in the second volume of the "North British Agriculturist." It occurs near London. Can it have been introduced from abroad with foreign beech plants? I find the cast wrapper of a caterpillar among the cotton of the Coccus, and formerly there was one alive concealed by it; but whether it feeds on it, I cannot say, but it is not unlikely. The Coccus will be difficult to extirpate, for it is not easy to scrape the bark and apply hot water to a beech.

Mr W. R. M'Nab remarked that Mr M'Intosh had noticed a similar diseased condition of the beech-trees in Dalkeith Park, and had recorded the facts in the first volume of the "North British Agriculturist." He seems to have considered it a fungus. The cottony matter was at that time sent to Mr Hardy, who ascertained that it was owing to an insect, and gave a description of it in the second volume of the same journal.

Mr M'Nab thinks the *Coccus fagi* appears only on trees in an unhealthy condition, or at least in situations where they are confined in their growth by close planting. Dr Balfour stated that the same species of Coccus had destroyed some beech-trees in the Botanic Garden, which had been planted very closely, and were hemmed in by shrubs and trees. It seems to attack healthy trees. The only remedy suggested was the application of spirit of tar or tobacco-juice. Dr Balfour remarked that the species of Coccus were often very destructive. One of them in 1842 destroyed the whole orange-trees in the island of Fayal, one of the Azores. The usual exportation of fruit from Fayal was 12,000 chests, but in 1842 there was not one. The insect extended its devastations to St Michaels. It was *Coccus hesperidum.* Specimens of thebeech-insect and of the cottony matter were shown.

3. *Notes in Reference to the Bursting of the Spathe of* Seaforthia elegans. By Mr John Sadler and Mr William Bell.

In this communication the authors first referred to an article which had lately appeared in the "Gardener's Chronicle" from the pen of Dr Seemann, describing the bursting of a spathe of *Seaforthia elegans,* with an audible report, "almost loud enough to have proceeded from a pistol," in the Palm-House at Kew—the explosion being attributed to "a great accumulation of heat, developed by the anthers whilst inside the spathe." The authors then stated that they had had ample opportunities for observing the flowers of the *Seaforthia* in all their different stages of development in the Palm-House at the Edinburgh Botanic Garden, and as yet had never seen anything which gave the least indication of a sudden rupturing of the spathe. In some cases they had seen the old foot-stalk of the leaf which covered the spathe fall off two or three days before the spathe showed any signs of bursting; and when it did burst, it opened gradually from the base to the apex, generally on the dorsal aspect; indeed, they had only observed a single instance where the rupture occurred on the ventral side. Again, they had seen the spathe burst two or three days before the old foot-stalk fell off, and when it fell upon the floor it generally gave a pretty sharp crack, which they thought had been probably regarded as proceeding from the bursting of the spathe, as Dr Seemann states that the spathe in bursting "forced off the remnant of the old leaf-stalk." When the spathe bursts previous to the fall of the foot-stalk that covers it, as soon as it is removed the branches of the spadix immediately expand, and, to all appearance, it looks exactly as if the spathe, in the act of bursting, had knocked off the foot-stalk. Dr Seemann supposes that the report was due to an accumulation of heat, produced by the anthers. This, however, the authors thought could not be the case, as a considerable time elapses between the bursting of the spathe and the opening of the flowers; this they had never observed to be less than three weeks, and generally more than a month. A tree in the Palm-House at the Botanic Garden burst its spathe five weeks ago, and had not yet a single flower expanded. After the bursting of the spathe the branches of the spadix continue to increase both in length and thickness; and until they have reached their maximum development, they had never seen a single flower expand. Dr Lindley, in his "Introduction to Botany," and Dr Balfour, in his "Class-Book," both state that the greatest amount of heat during the period of flowering is when the anthers are ready to discharge their pollen, after which it gradually declines. At the time the spathe bursts the flowers are in a very imperfect state, the stamens being very immature, with no traces of pollen. The observations of the authors went to show that there was rather less heat inside the spathe before it bursts than there was in the surrounding atmosphere. They had inserted a thermometer by a narrow slit into an unburst spathe, where they allowed it to remain upwards of twenty minutes, and when taken out it stood at 57½°, while the surrounding atmosphere was 58°. Taking into consideration the structure of the spathe, the authors showed that it was incapable of sustaining any great amount of pressure, as it was found, when in a fresh state, to tear lengthways with as little resistance and with as little noise as a piece of soft paper.

4. *Notes regarding some New and Rare British Mosses.*

By Mr John Sadler.

Mr Sadler stated that, as he had received several letters from correspondents during the last few months, containing valuable information respecting some interesting British mosses, he thought it well to bring before the Society a few extracts from these communications, in order that they might be recorded in their Proceedings.

(1.) *From* Mr William Wilson, Paddington, near Warrington.

"We have near Warrington an excavation at the side of the railway whence the embankment of the railway is supplied. In the marsh thus formed has appeared, along with *Bartramia fontana*, a new and allied species *B.* (*Philonotis*) *cæspitosa*, which Schimper has found in Sweden; but it seems otherwise a stranger. There are also many good mosses in this swamp not known to grow very near to it elsewhere. On the other hand, several mosses, which do grow not far off in similar situations, do not grow there; but *Bryum bimum* and *B. pallens* are there in great plenty, and in very fine state. *B. annotinum* is there also, and bears fruit.

If *Philonotis cæspitosa* does not bear fruit this spring I shall send you living plants (male and female) to be nursed up to perfection in your stoves. I think that *Hypnum elegans* may also require some such treatment. It is plentiful enough in Britain; but the fruit is very rare. The plant resembles *H. cordifolium*, and has been overlooked as a variety; but it is a diœcious moss. The bog at Wybunbury, in which it occurs sparingly in fruit, has been recently drained, and will soon be destroyed as a station for mosses."

(2.) *From* Dr J. B. Wood, Manchester.

"*Tortula Mulleri* has been gathered for several years near Blair Athole, by Miss M'Inroy of Lude. *Bryum Duvalii* was gathered about two years ago by Mr Nowell on Helvellyn. I enclose you specimens of, 1. *Hypnum Eugyrium*, of Schimper's "Synopsis," 1860, from near the Rumbling Bridge, Fifeshire, collected June 1861. This is the first time that this moss has been detected in Scotland.[*] 2. *Orthotrichum anomalum* of Hedwig's "Bry. Europ.," not of Hooker and Taylor, nor of "Bry. Brit.," which is *O. saxatile*, Bridel. *vide* Phytol. On detached rocks near Aberdour, June 1861. 3. *Orthotrichum Sturmii*, Omberg Dalvarlia, Zettersteat legit, Schimper misit! Fruit not good, and scarce. I will send you a British example when I have time. You may value these as coming from such a source."

---

[*] In this, however, Dr Wood is mistaken, as I find that the plant was collected in April 1858 by the late Dr William Nichol, at the Grey Mare's Tail, in Moffatdale, and recorded by him in the Society's "Transactions," vol. vi. p. 140, where he says, "*Limnobium* (*Hypnum*) *Eugyrium*, *Sch.*, Grey Mare's Tail, in fruit. This plant is not recorded in Wilson's "Bryologia Britannica," having at that time been confounded with *Limnobium palustre*, Sch. It may, however, be easily distinguished by its yellowish aspect and the much enlarged alar cells of the leaf. The only other British stations are Turk Cascade, Killarney, and Aber Waterfall, North Wales."

(3.) *From* Mr James Horsefield, Whitefield, near Manchester.

"I take the liberty of sending you specimens of *Tortula marginata*, *Entosthodon Templetonii*, and *Dicranum crispum*, all of which I have gathered in this locality."

(4.) *From* Mr James Cook, Manchester.

"Enclosed are specimens of *Orthodontium gracile* from Mr Wilson's station, Alderley Edge, Cheshire, and *Atrichum laxifolium* from Staley Brushes, Ashton-under-Lyne. The latter moss is not named in Wilson's "Bryology;" but specimens from the same station were sent to Dr Schimper, who named it as above. It has not yet been found in fruit in Britain."

(5.) *From* Mr John Nowell, Todmorden.

"I met with *Bryum Duvalii* on Helvellyn in July 1859; but not knowing anything of that plant then, I thought it might be a form of some other *Bryum*, and unfortunately did not procure much of it. Very soon afterwards a friend of mine sent me a small scrap of the moss gathered by Dr Nichol, and it turned out to be identical with the one I had picked on Helvellyn. I enclose a few specimens of mosses, and hope they will prove acceptable. One of them is the *Atrichum laxifolium* of Wils. MSS. of James's Plants of New Jersey. I have known this moss for a good number of years, and have shown it to several botanists, who have come to the conclusion that it might be a form of *A. undulatum*, or perhaps turn out to be *A. tenellum*. Last year specimens of it were sent to Dr Schimper, who pronounced it the true *A. laxifolium*, and new to the Flora of Europe. It is not unfrequent by the sides of streams on the hills in this district; and it has lately been found in one or two other places in Lancashire. Mr Wilson has also found it on the edge of Oak Mere, in Cheshire. Only the male plant has been detected in this country. *Bryum stellare*, on moist shady rocks, Shedden Clough, near Barnsley, Yorkshire. *Mnium subglobosum*, boggy moors, near Todmorden."

(6.) *From* Mr George Brearly, Milnrow, Rockdale.

"I have sent you *Dicranum Dillenii*, from near Garstang, *Hypnum riparium*, from near Milnrow: *H. polygamum*, *Bryum calophyllum*, *B. Warneum*, &c., from near Southport, collected November 1859."

(7.) *From* Mr Alexander M'Kinlay, Glasgow.

"I enclose *Orthotrichum orneum*, of Dr Schimper's MSS. (*O. Daliense*, Wils. MSS.) gathered on ash trees near Dailly, Ayrshire; discovered by Mr John Shaw, June 1860. *Zygodon conoides*, old trees, Dailly, May 1860: *Hypnum hamulosum*, *H. umbratum*, and *H. crista-castrensis* in fruit, Trossachs, 1860. *Tortula rigida*, on clay, by the Paisley Canal, near Glasgow, September 1860."

In a letter which I received from Mr Wilson, and published in the Society's Transactions, vol. vii., p. 107, he says:—"The late Dr Nichol sent me some years ago a small specimen of a moss which he considered to be *Atrichum tenellum*, gathered near Lochgoilhead in 1856. This I cannot find in my herbarium, after repeated search, nor elsewhere among my papers, and I have no memorandum of having examined it. I am particularly desirous to receive from you a duplicate of this moss, that I may ascertain what it really is. I hope it is *Atrichum tenellum*, but have much doubt on the subject. It may prove to be the same as a new

British species allied to *A. tenellum*, and which I believe we must now call *A. crispum*."

Mr Wilson now writes, December 27th, 1861:—

(8.) "Since I wrote to you I have been fortunate enough to find the lost specimens of *Atrichum tenellum*, sent to me by Dr Wm. Nichol, in August 1858. It quite agrees with authentic specimens from Dr Schimper—I am sorry I cannot spare any of the Scottish ones; for I have only two stems with fruit (unripe). These agree in size and character with what I send enclosed. The habitat given is "near Loch Goil Head, on a sandy bank by the side of road thence to St Catherine's, Loch Fyne Side, not far from the head of Hell's Glen, 1856." I am very glad to have established the claim of Dr Nichol to be remembered as the discoverer (in Britain, &c.), of the true *A. tenellum*. Is there any prospect of getting a supply of the moss (now in season)? The habitat seems to have been very exactly noted, and I should have no fear of finding it. The short capsule distinguishes the moss at once from *A. undulatum*; but it is also distinct in inflorescence, being diœcious. I wish I could see the fertile specimen of *Hypnum sarmentosum*, gathered on Ben Beck, July 1845, by Wm. Gardner. The loan of it would oblige, and I would carefully examine and return it. The only satisfactory way in such cases, is to disentangle, and completely separate the specimen from all its accompaniments. Has this been done? The mere presence of a capsule in a tuft of the moss is not at all conclusive evidence. I am rather dubious about *Orthotrichum speciosum*, from Penton Linns, 1858, Dr Nichol. The specimen is much overripe and meagre. Most of the specimens sent by Dr Nichol as *O. pulchellum*, trees, Annan water, near Moffat, April 1858, seem to belong to another species, and should be well compared with *O. patens*, a species I do not yet properly understand. It appears that *Dicranodontium longirostre* does really grow on Ben Lawers as well as on Ben Ledi, as I have a specimen gathered this year from Mr M'Kinlay. Enclosed are specimens of *Hypnum speciosum*, collected near Penzance, December 1861."

(9.) *Dicranodontium longirostre* was first detected by Mr Wm. Bell on Ben Ledi in July 1860; and Mr Wilson, in a note to him, says:—"You have gathered another interesting moss on Ben Ledi, about whose exact locality I should be glad to have information. It is *Dicranodontium longirostre*. I have never spent much time on that part of Ben Lawers where you found *Bryum Duvalii*. Indeed, I have only twice passed over that ground, and then in haste. I may mention that when Dr Schimper was over here, he called many specimens which I showed him, '*Bryum turbinatum*," which I knew to be a variety of *B. pallens* only. This shows how easily they may be mistaken for each other in a dry state. *Bryum turbinatum* is a very rare moss in Britain. Hitherto only three stations have been found, and two of these are already destroyed. I have never gathered it myself with fruit, and very few such have been gathered at all."

(10.) *From* Mr William Bell, Edinburgh Botanic Garden.

"In the month of April last I spent two days in the neighbourhood of Moffat. Amongst other places of interest to the muscologist I visited Dob's Linn, where I met with *Zygodon Mougeotii* in fruit, a thing apparently of rare occurrence, the only other British specimen in fruit being gathered by Professor Walker-Arnott somewhere on the Clova Mountains. In the woods of Dumcrief I gathered *Orthotrichum phyllanthum* and *O. stramineum*. I found *Mnium stellare* and *Bryum Duvalii* abundant in Dr Nichol's stations—the former by the roadside between Moffat and the Grey Mare's Tail, and the latter at the source of the Mineral Well Burn. During last summer I collected *Fissidens serrulatus*, on Arthur's

Seat: *Fissidens viridulus*, in Greyfriar's Churchyard: and *Pottia Wilsoni* on the top of an old wall near Haymarket Station. These three species, I believe, have not been hitherto observed in the neighbourhood of Edinburgh. I have found *Tortula papillosa* on an ash tree in the Botanic Garden; on the trunk of a large willow lying in a woodyard between Broughton Place and Leith Walk; and also on ash trees a little to the east of Gilmerton. Dr Nichol mentions having found it 'on a rock on Arthur's Seat; a very anomalous situation.'"*

Specimens of the various species of mosses referred to were exhibited.

5. *Remarks on the Specimens of* Araucaria imbricata *in the Botanic Garden.* By Mr M'Nab.

The ever-memorable 24th December 1860, when the thermometer in the Botanic Garden stood at -6°, injured to a fearful extent many trees and shrubs, which had stood during the last half century unprotected and uninjured. Foremost amongst the victims was the *Araucaria imbricata*, first introduced into Britain in the year 1796 from Chili, where it is found growing with stems 150 feet in height. The first symptom of injury observable on the two largest plants in the garden was the peculiar drooping of all the points, both primary and secondary, of every branch. As the spring advanced, the drooping points became brown, and were ultimately blown off. During summer all the lower branches and the points of the upper ones also became brown and dry, so much so that their removal was absolutely necessary. As the season advanced, not a green portion was to be seen. After the top shoots became brown, the stems began gradually to die downwards. The finest plant was cut down exactly one year after being injured, when two or three inches only of the stem, close to the surface of the ground, were found to be healthy, and from which it is expected buds will push during the coming spring. The smaller-sized specimens cut down last year commenced to give out buds immediately. The lower they are cut the fewer and stronger will be the shoots produced. These must be finally thinned out to single stems. It is curious to observe four plants in the garden having their top-whorls perfectly fresh but denuded of all the lower branches, probably arising from the depth of snow which rested on the upper whorl; while those having a terminal shoot above the upper whorl all died. The few plants saved appeared more delicate than the two noble plants which stood at each end of the long terrace lawn, and where the subsoil is deep dry sand, but both are now dead. During the last fifteen years, the two large plants were regularly supplied every May each with thirty barrels of water, besides a triennal renewal of the soil round the extremities of the roots, composed of very old rotted manure and loam. This may account for the very large size of the annual layers produced during the last fifteen years, compared with those sections where no extra water was given. For many years past a good deal of speculation has been going on with reference to the tiers of branches, as compared with the probable age of the trees. The cutting down of different sized trees in the Garden has given us an opportunity of setting this matter, so far, at rest. The largest plant cut down was 24 feet 6 inches high, and 4 feet in circumference at the base. This plant has 30 perfect annual rings, and 20 perfect whorls of branches, proving that eighteen months are necessary to complete one internode and whorl. Two others cut down, both about 16 feet in height and 15 perfect tiers of branches, besides an unbranched terminal shoot, and 23 annual rings. Many others averaging 8 feet in height have 8 perfect whorls, with unbranched terminal shoots, and about

---

* Bot. Soc. Trans. vol. vi. p. 110.

13 annual rings. To tell the age of a growing plant of *Araucaria*, count the tiers of branches, and add one-half the number, making allowance for the unbranched terminal shoot, if any; this will give nearly the age of each tree. Some of the older plants, particularly those which had been confined in pots during their early growth, show a slight discrepancy in the lower whorls; in general the above test will be found very near the truth. It is not to be expected that plants ill-treated, or growing in very exposed situations, or bad undrained soil, will at all answer the above test. *Araucaria* and *Altingia* are perhaps the only plants whose external appearances indicate their exact age. Mr M'Nab exhibited a section of the stem of the largest Araucaria.

6. *Notice of a Plant called by Travellers in Canada the Polar Plant.*

By William Gorrie, Esq.

Mr Gorrie called attention to the various notices of this plant in different works, and stated that he was unable to determine the correctness of the observations, or to ascertain the botanical name of the plant to which allusion was made. The following are some of the references to this plant:—1. "The Scalp-hunters," by Captain Mayne Reid, 1852, p. 206—"But we had a guide to our direction unerring as the magnetic needle. We were traversing the region of the 'Polar plant,' the planes of whose leaves at almost every step pointed out our meridian. It grew upon our track, and was crushed under the hoofs of our horses as we rode onwards." 2. "The City of the Saints," by R. F. Burton, 1861, p. 60—"Whilst in the damper ground appeared the Polar plant—that prairie compass, the plane of whose leaf ever turns towards the magnetic meridian." 3. "The Prince of Wales in Canada and the United States," by the *Times*' Special Correspondent, 1861, p. 300—"Fortunately none go to the prairie for the first time without being shown, in case of such mishaps, the groups of compass weed which abound all over the plains, and the broad flat leaves of which point due north and south with an accuracy as unvarying as that of the magnetic needle itself." 4. "Notes by Lieutenant-Colonel W. H. Emory, made in 1846–47, with the advance guard of the 'Army of the West,'" 1848, p. 11—"On the uplands the grass is luxuriant, and occasionally is found the wild tea (*Amorpha canesceus*) and *Pilot weed* (*Silphium laciniatum*). The low grounds abound in prickly rush, narrow-leaved asclepias, while flowering indigo, flowering rush, spotted tulip, bed straw, wild bergamot, spiderwort, pink spiderwort, pomme blande (*Psoralea esculenta*), scarlet malva, *pilot weed*, hazels," &c. Again, at p. 143 of same work, "*Silphium laciniatum* (pilot-weed) was found on the Arkansas and its tributaries. Another *Silphium*, with large ovate undivided leaves, was found in Cario Creek, in lat. 32°, long. 116°, Old California." In same work, Appendix, No. 6, Lieutenant J. W. Albert's Notes, p. 388—"The prairie was yet what is called rolling; the flat bottoms were covered with the rosin weed or *Polar plant* (*Silphium laciniatum*), whose pinnate parted leaves have their lobes extending like fingers on each side of the midrib. It is said that the planes of the leaves of this plant are coincident with the plane of the meridian; but those I have noticed must have been influenced by some local attraction that deranged their polarity." Mr Gorrie stated that there was no notice taken of the "Polar plant" either in Strausburg's "Expedition to the Great Salt Lake," 1852, or in Fremont's 1st and 2d editions.

Professor Balfour exhibited a photograph of a cedar of Lebanon (*Cedrus Libani*), which had been presented to the Museum at the Botanic Garden by the Right Hon. R. C. Nisbet Hamilton. The photograph was executed by Mr D. Campbell of Ayr. The following are the particulars relative to the tree:—It grew at Beil, where it was planted in 1707. It was measured on December 23, 1861—

Height, . . .	59 feet 3 inches.
Girth at the root, . .	16 ,, 1 ,,
Do. at 4½ feet, . .	18 ,, 6 ,,
Spread of branches, . .	77 ,, 3 ,,

Mr W. R. M'Nab exhibited specimens of the pine-destroying beetle (*Hylurgus piniperda*), which had been sent from Churchill, Verner's Bridge, Mayo, Ireland, by Mr J. B. Webster, wood forester to Sir William Verner, Bart., M.P. Shoots of the pines destroyed by the beetle were also shown.

Professor Balfour stated that he had received a letter from Dr Cleghorn, dated Cawnpore, 2d December 1861, in which he states that he had been able to convey the *Cinchona* plants safely from Kew to Madras, and that he had despatched them to the Nilgiris to be planted. Dr Cleghorn was on his way to the Punjaub, to examine the forests there.

13*th February* 1861.—T. C. Archer, Esq., President, in the Chair.

The following Communications were read:—

1. *On the Farinaceous Grains, and the various kinds of Pulse used in Southern India.* By Walter Elliot, Esq. of Wolfelee.

(This paper will appear in the next number of the Journal.)

On the Homologies of the Sporiferous Appendices of Anemia, &c. By John Scott, Royal Botanic Garden, Edinburgh.

The nature of the spores of ferns has long been, and still continues to be, an open question, in the history of their morphology, principally, perhaps, from the following peculiarities:—*First*, Their origin, as productions of a free cell-formation, like the pollen-grains of Phænogams, with which they have been considered as homologous, although subserving dissimilar functions. *Second*, The anomalous appearance of organs, supposed by many to exercise reproductive functions, upon a temporary structure, developed from the spore after its separation from the plant, which has given rise to the opinion of the spore being the homologue of the floral-bud in Phænogams. And again, *thirdly*, the fact that the spore, unlike the seeds of the higher plants, possesses an individuality which reproduces and establishes, with the utmost facility, any peculiarity that may appear on the pinna upon which it originates,—a property which in Phænogams is almost exclusively confined to the leaf-buds; hence the opinion that they are the homologues of the leaf-bud. These, then, are a few of the peculiarities of the fern-spore, which we fear will continue to tax the most ingenious of our vegetable morphologists for a satisfactory explanation of their homology.

The subject, however, which we have proposed for our examination at present has to do simply with the homologies of the parts bearing these organs, and is of a less complex nature than the one we have cursorily noticed. In the majority of ferns there is comparatively little difference between the sterile and fertile frond; in others, however, there is a very marked dissimilarity. For example, in certain genera of the tribe Schizæineæ, the morphological conformation of the spore-bearing parts is so peculiar—considering their relative position—that doubts are entertained as to their true nature, and we have at present two very different explanations of their structure. The genera which have occasioned this difference of opinion are Anemia and Anemidictyon, and the first structural explanation of their fertile fronds, was, we suppose, proposed by Endlicher. He regards the fertile appendices in these genera as the lower pair of pinnæ in a changed and modified state. The late Mr Gardner has, however, given a very different explanation: he regarded the fertile frond as compounded of three originally distinct fronds. The stipal parts being incorporated, separation taking place at the base of the rachis, where one assumes the appearance and habit of the normal barren frond; the other two, rising laterally from this, have the parenchyma almost entirely suppressed, forming two erect sporiferous appendices.

Among the arguments adduced by Gardner in support of this view, we may mention the following, which he considered as disproving the explanation given by Endlicher. The fertile fronds in the genus Mohria arise separately from the rhizoma, and do not differ in general appearance from the barren ones. In two ferns which Gardner discovered in Brazil, closely allied to Anemia and Mohria—to the latter, at least, in bearing distinct sterile and fertile fronds—abnormal specimens occur, in which the lower part of a frond alone is contracted and sporiferous, the upper a perfect fac-simile of the same portion of the barren frond. We may mention, *e.g.*, that as he could not satisfactorily refer these ferns to any existing genus, he formed one for them—Coptophyllum. Smith, however, in his paper on the "Genera of Ferns," has referred them to the genus Mohria; and latterly, Moore, in his "Index Filicum," has placed them in Anemia. In these two abnormal specimens, then, we have the sporiferous parts in apparently the same conditions as occur in Anemia, so what explanation can be given of the diversity of appearance assumed by those parts in their respective genera, if we do not consider the fertile frond in Anemia as compounded of three? And again, he considered the idea of the mere transformation of the pinnæ into the sporiferous parts disproved by the circumstance, that in *Anemia Mandioccana* the fertile spikes are opposite each other, while the pinnæ alternate. We may here state that there can be little stress laid on the opposition of these parts, as it is not at all permanent. On looking over a series of specimens of *A. Mandioccana*, we observe that these parts are as often seen to alternate as assume an opposite position; and in *Anemia flexuosa* the fertile panicles are sometimes half an inch apart; at other times they are opposite; and so it is with many others belonging the genus. It is evident, however, that the law regulating the fertile parts bears no relation to that observed in the arrangement of the pinnæ, as there is always a regular alternation in the position of the latter, the distance between them decreasing from the base to the apex of the frond.

Having now stated the two opinions held regarding the structure of the sporiferous appendices of Anemia, we will attempt an explanation of the true nature of these parts, which we propose doing in the following manner—*First*, by examining the nature of the sporiferous parts in allied genera, in search of analogical elucidations; and, *secondly*, by laying before you a series of teratological illustrations from plants of Anemia and Anemidictyon. As the tribe Schizæineæ is a very small one, we will give a cursory description of the sporiferous parts in each of the genera.

1. *Lygodium*, taking the *L. palmatum* as characteristic of the genus, which has a slender, wiry rachis rising from the rhizoma, bearing at intervals opposite pairs of dichotomous pinnæ, reniform and palmate, the segments of the barren parts are fully half-an-inch broad. In some fronds we pass directly from these broadly palmate pinnæ to the rachiform and sporiferous pinnæ, which form a terminal panicle. At other times there is a more gradual transition from the sterile to the fertile parts,—*e.g.*, in

a dichotomous pinnæ, one pinna alone is contracted and sporiferous, the other preserving the normal barren form, thus exhibiting a striking indefiniteness in the modifying cause. It is obvious, however, that the sporangia in this genus are borne in panicles formed by a transformation of the ultimate pinnæ.

2. In the genus *Schizæa* the fronds are simple, flabellate, or dichotomously multipartite, the fertile bearing on their apex a crest of linear sporiferous segments. This genus has been divided into three sections. In the first occurs the *Schizæa pusilla*, the fronds of which are simple and linear in the barren state; in the fertile, the apex is transformed into a reflexed crest of pinnate, linear segments, bearing the sporangia. In the second group occurs *S. dichotoma*, with fronds dichotomously multipartite; segments linear in the barren state; in the fertile the linear segments terminate in a pinnate sporiferous crest. Again, in the third section, we have *S. trilateralis*, the barren fronds of which are simple, linear, and triquetrous, the apex of these in the fertile state, as in the others, forming a crest of pinnate segments.

In this genus there is a striking departure from the normal structure of the frond—assuming the barren fronds as such—in the terminal crest of fertile segments, each of which is a miniature fac-simile of the sterile frond. Now, in some of these, *e.g. Schizæa bifida*, or in *S. pectinata*, there are from ten to twenty of these segments rising up in a more or less erect position from the reclinate continuation of the costa: so that if three fronds are required to form a fertile frond in Anemia, how many have we in that of Schizæa? There is, in fact, stronger presumptive evidence for the fertile fronds being compounded of a number, similar to the segments of the sporiferous crest in Schizæa than there is in Anemia, as in the latter genus we have in the pinnæ lateral appendages, which we might regard as the homologue of the sporiferous panicle; but in Schizæa we have no such appendages on the barren frond; consequently, admitting the fertile fronds of Anemia to be compounded of three from the tripartite condition of these fronds, we must, for consistency, give a similar explanation to the structure of Schizæa, and consider it as composed of a number similar to the sporiferous segments. But we fear that this view of the structure of the fertile frond of Schizæa would find few to support it; and, as we cannot apply the other view, from the absence of lateral appendages in the barren fronds, we must either consider the sporiferous crest as a special development—a superinduced structure—or, perhaps, with more propriety, regard it as a product of collateral chorization, for the barren frond has only an analogical affinity with the phyllodium. The structure of the fertile frond in Schizæa, when compared with the same in the other genera of the tribe, appears to be quite anomalous, consequently of no analogical value in illustrating the homology of the sporiferous parts in the other genera.

3. In *Mohria*, the sterile and fertile fronds rise independently from the rhizoma, the fertile being more or less contracted, at times forming a mere rachiform panicle, on which the sporangia are disposed. In *Mohria millefolium*, Smith, specimens sometimes occur in which the basal pair of pinnæ alone are contracted and sporiferous,—a condition which Gardner thought confirmed his view of the structure of the fertile frond of Anemia. As in these abnormal fronds we have, according to Endlicher's view of the structure of Anemia, a conditional similarity between the two genera, and yet these abnormal forms of Mohria do not produce erect panicles similar to Anemia. Hence he seems to have concluded, as we stated before, that there must necessarily be a difference in the internal structure of the two genera to explain the difference in their morphological conformation. We may, however, remark that the basal sporiferous pinnæ of

Mohria do not stand in the same relative position to the others as the sporiferous panicles of Anemia do, so that there is, in fact, a difference in the external structure of the two which Gardner has entirely overlooked: the morphological influence it exercises we will fully elucidate in our observations on Anemia.

4. The genus *Trochopterus* is founded on a single species—*T. elegans*, discovered by Gardner in Brazil. The fronds are simple, subrotund, five-lobed, the two lower lobes contracted, laciniated, and bearing the sporangia. This curious little plant, whose fronds are rarely more than three-fourths of an inch long, and half an inch broad, differs from Anemia, according to Smith, only in habit,—the fronds being depressed, horizontal, closely imbricated, and developed in a regular spiral alternation, forming a flat circular patch an inch and a half in diameter. In this genus, then, as in the others which we have examined, Schizæa excepted, it is very obvious that the sporangia are borne on the more or less modified pinnæ of the individual fronds.

Next in succession, we reach the genera which have given rise to the difference of opinion—Anemia and Anemidictyon. In both the genera the fertile fronds are ternately branched; two of these branches are erect and sporiferous, the other spreading and sterile, similar to the barren frond characteristic of the species. We will now proceed to describe a series of abnormal forms, which we trust will illustrate most clearly the true nature of the sporiferous appendices in the true genera.

In our first illustration—*Anemidictyon Phyllitidis*—we have a barren frond, exhibiting a decided, though frustrated, tendency in the lower pair of pinnæ to form a normal sporiferous panicle. These pinnæ, instead of being entire and developed on the same plane with the others on the rachis, are pinnatisect, with lanceolate obtuse segments; they also assume the erect position, with their upper surfaces in opposition, like the normal sporiferous panicles. There is also observable a departure from the usual law followed in the rachidial disposition of the pinnæ by these abnormal forms. In a normal barren frond, the first and second pair of pinnæ are always farthest apart, a gradual decrease of the distance between them taking place from the base to the apex; whereas, in the specimen before us, the basal, pinnatisect pinnæ rise from the rachis scarcely half-an-inch below the second pair of pinnæ, while the distance between the second and third pair is nearly an inch and a quarter. In this case, then, we appear to have something analogous to the extra-axillary development of buds, an adhesion of the petiole with the rachis. Admitting the doctrine of secondary influences, we may assume *adhesion* in this instance, and accept it as a key for the explanation of the peculiar morphological conformation of the sporiferous panicles in Anemia. Our succeeding illustrations will, we trust, place on a more satisfactory basis the opinion we have here assumed, by showing that there is a certain apparent relation between the degree of modification of the pinnæ and the amount of their rachidial adhesion.

In our second specimen of *A. Phyllitidis*, the sporiferous panicles are both fully developed, the left side panicle being placed in juxtaposition with the barren pinnæ, as is usually the case; but on the right side the panicle is solitary, and a little below the first barren pinnæ on this side occur the pinnæ which normally ought to have been given off by the rachis, in proximity with the sporiferous panicle, as occurs on the left side. In this illustration, then, we have an example of the adhesion of two of the pinnæ with the rachis on the right side, both of which have undergone a complete transformation,—the first, or basal, being perfectly developed into a sporiferous panicle; the second assumes the form of a narrow linear rachis an inch and a half long, with eight or nine sporiferous lobules forming a crest at its apex. The imperfect conformation of the secondary panicle may in all probability be attributed to the more rapid and powerful development of the primary or basal panicle. Now, as no doubt can be entertained that this secondary panicle, in ordinary circumstances, would have been developed as a normal barren pinna, we regard it as a most unequivocal demonstration of the opinion we assumed—viz., that the simple pinnæ of the frond, on adhering with the rachis, do partake of its nature, and assume its general morphological conformation.

In our third illustration—*Anemia collina*—there is a very slight adhesion of the lower pair of pinnæ with the rachis, and, consequently, they undergo a very trifling modification. They are about the same length as the ordinary barren pinnæ; but from the adhesion they have partaken of the rachidial habit, and rise up erectly, contracted, rachiform at the base, bearing small sporiferous segments, and terminating in a large obovate lobe. Again, in our fourth specimen—*Anemia collina*—we have a very clear demonstration of the dependence of the transformation on the degree of rachidial adhesion. In the specimen before us, the basal pinna on the left side has partially adhered with the rachis, and assumes the erect habit, the basal part pinnatisect, with a large terminal lobe; on the right side the lower pinna has had a greater adhesion with the rachis, rising from it a little below the secondary pinna, and here, though the development has been frustrated, the transformation is complete, as it has assumed quite a rachiform appearance, terminating in a small crest of sporiferous segments.

In the preceding parts of this paper, we referred to an argument Gardner drew from abnormal specimens, belonging to certain species of Mohria, which he thought supported his structural views of Anemia. These specimens—the structure of which we before noticed—he assumed to be in the same structural condition as the fertile fronds of Anemia, according to Endlicher's view; so, upon this purely negative evidence, he postulates that, as the conformation of the two are so very dissimilar, there must be a dissimilarity in their internal structure, hence the origination of his ingenious though unsubstantiated theory, that the fertile fronds of Anemia are compounded of three originally distinct fronds. The teratological specimens, however, that we have laid before you clearly demonstrate that there is a conditional dissimilarity in the external structure of Anemia, and the abnormal specimens in question, which must have escaped Gardner's observation, or no doubt the argument, which it nullifies, would not have been brought forward.

Before concluding our paper, we may cursorily notice a few objections to Gardner's theory, which occurred to us on first considering it, although from the want of the abnormal specimens we have placed before you, we were unable to give any satisfactory answer to his query, Why the pinnæ of Anemia assume such a peculiar conformation? First, then, in tracing the development of a fertile frond, we are at once induced to regard the fertile appendices as simply modifications of pinnæ, from the fact that they are primarily developed in the same order; whereas, had they been originally distinct fronds, the degree of "developmental energy" possessed by them would have been equal to the barren part, and thus demonstrated their nature by being developed in the same order. Again, on examining the vernation of the appendices, we find that it agrees perfectly with the other pinnæ; they simply fold over the first pair of pinnæ, as these do over the second, instead of being rolled up in a circinate manner, as the rachidial part invariably is.

The truth of the foregoing remarks, on determining the nature of the sporiferous appendices by their order of development, is practically elucidated on tracing the development of specimens such as those we now lay before you, in which there has been a connection of stipes. In the first example—*Anemia collina*—the stipal parts have adhered for a short way, when a lateral separation takes place, and each part then assumes the appearance of a normal frond, having at its base the incipient fertile parts, which, from some unknown cause, have been arrested in their development. In a second example, we have, in a specimen of *Anemidictyon Phyllitidis*, a connation of three fronds, collateral separation taking place very near the base of the stipes. Two of the fronds are fully developed and fertile, the third was unfortunately broken; the pinnæ and fertile parts were, however, perfectly formed upon it. Now, in tracing the development of fronds such as these, we have no difficulty in discerning their compound nature at a stage prior to the development of the lateral appendages, which at once points to a structural dissimilarity; whereas, in a fertile frond of Anemia, the sporiferous appendices, as we stated before, follow the same order of development as the lateral appendages, appearing as small conical papillæ undistinguishable from them, thus confirming the belief of their homologous nature.

The history of development, in thus showing the original uniformity and homogeneity of the sporiferous appendices and pinnæ, confirms the analogical indications derived from allied genera in a preceding part, as well as the elucidations given—of a gradational metamorphoses of pinnæ into sporiferous appendices—by the teratological specimens; and thus conjunctly afford indubitable evidence of the sporiferous appendices being, as Endlicher supposed, modifications of pinnæ; their peculiar morphological conformation being specifically dependent on the amount of adhesion with the rachis; or, strictly speaking, on the non-development of the interpetiolar part—as these appendices do not originate any closer to the pinnæ immediately succeeding, than these do successively each other, the interpetiolar parts being, of course, a subsequent development.

3. *Excerpt from Letter from Mr William Shiress, Chemist and Gold Assayer, Sandhurst, Victoria, Australia, relative to the late Expedition to the Gulf of Carpentaria, with a Notice of the Nardoo Plant* (Marsilea quadrifolia?). Communicated by Professor Balfour.

"Sandhurst, Victoria, *25th November* 1861.

"The great event of the month has been the news of the discovery of the fate of the exploring party of Burke and Wills, by Mr Howitt, who was sent out as leader of a contingent party to search for the missing explorers. Never was there such a melancholy story told to a sympathising public, as that which Mr Howitt's researches has unfolded. You will see fully by the papers sent all that has as yet been printed; but, by next mail, I shall send supplementary intelligence, which will be as complete as it ever can be. The harrowing facts may be told in a few words. Towards the end of December 1860, Burke, after having established a depôt of provisions at Cooper's Creek (left in charge of Mr Brahe and a few men), started in company of Messrs Wills, King, and Gray, with several camels and horses, and three months' provisions, to try to accomplish the main object of the expedition, viz. crossing to the Gulf of Carpentaria,—a feat, though often attempted, never before accomplished. By the diary of Wills, which is singularly incomplete, you will see, that, finding a glorious, well-watered country all the way, they found the flow of the tide of the sea in Albert River, in February of this year; and, after spending three days upon the shores of the Gulf of Carpentaria, they started to retrace their steps. But, long before Cooper's Creek could be reached, it became evident that food must fall short; and, consequently, they put themselves upon rations just sufficient to sustain life, and toiled on, having their diet increased and varied by the flesh of their horses, a large snake, &c. The camels, reduced to two, could barely drag themselves along, and were useless as a means of transit; and the worn-out explorers could, with the utmost exertion, only make three miles a day. When within a few miles of the longed for depôt, Gray gave way and died. On the 21st of April, towards evening, they at length reached Cooper's Creek and the depôt; but, alas! alas! found that Brahe had, *that very morning*, started on his way back, with camels and horses in first-rate condition, he having abandoned all hope of their return. They found a tree marked "21st April, Dig." On digging they found that Brahe had left a few weeks' provisions, but no clothing. Being utterly unable to attempt on foot to overtake a party mounted on strong camels and horses, they remained a few days to recruit, and got wonderfully revived. As the nearest point of civilization upon the Melbourne route was Menindie, 400 miles distant, they resolved to try to make a point in South Australia, 150 miles distant. But a toilsome journey of a few days exhausted all their food; and, killing the remaining camels, they "jerked" the meat; and despairing of their own weak laborious efforts accomplishing their deliverance, they sought the assistance of the native blacks, who had from time to time supplied them with fish. The blacks had, in addition to fish, given them some pounded Nardoo seed. Finding they could not support themselves, they wished to live with the savages until help should come, but the blacks had shifted their quarters, and could not be come at. Fortunately King discovered the Nardoo plant, and the collecting and pounding the seed occupied a good deal of their time. Wills was gradually sinking, and was unable to move; and, having placed him in a native wurley (hut), and left a plentiful supply of Nardoo within his reach, Burke and King set off in search of the blacks. Burke's strength however gave way, and he died: and, at his own request, King left him unburied, lying in the wilderness with a revolver in his hand. Such was the end of a gallant man! On returning to where he had left poor Wills, King found that death had claimed him too; and, scooping a hole with his hands, he gave him what burial he could. He then set off alone, and fortunately fell in with a party of blacks, by whom he was most kindly treated, until he was discovered by Mr Howitt's party, and succoured. We had the news in Sandhurst three weeks ago, but King only arrived here on Saturday (23d), and left for Melbourne this morning. An inquiry is being held there upon the subject, and at present the public mind is divided between sorrow for their fate and indignation at the cause of it; the Royal Exploration Committee getting a share of the blame, which justly falls upon Brahe for having deserted his post. Howitt speaks of saving the Nardoo which he found by the bodies of Burke and Wills. King has brought it down; and by favour, I have the pleasure of enclosing two of the seeds for your inspection, and as a relic of this glorious, though ill-fated, expedition. You may prize the seeds more highly in Scotland, when I tell you that I could get double their weight in gold for them. The Nardoo only grows in the far north; and although the natives live upon it, the experience had of it by the explorers, shows that it does not afford the requisite nutriment to Europeans. Mr M'Nab of the Botanical Gardens might contrive to grow the seeds, which will always have an interest attaching to them, although the plant may be common enough by and by.

4. *Paper on Cotton, transmitted by the Agri-Horticultural Society of Madras.* Communicated by Professor Balfour.

The Rev. Mr Macfarlane writes to the Madras Government as follows:

—"Much has been done in recent years, and great expense has been incurred, to improve the quality of Indian cotton by the introduction of foreign seed, but comparatively little to improve the indigenous plant (probably *Gossypium obtusifolium*), which, possessing certain acknowledged advantages over exotics, has yet important defects, such as brittleness and shortness of staple, which by improvement in cultivation, but still more in the quality of the seed, may, it is believed, be wholly removed. This may be done first by careful and high cultivation, and continuous and careful selection of the best seed, by which it can be made to outgrow in the course of two or three croppings its present defects, in the same manner and by the same process successfully followed in England, by which cereals and other seeds are improved, and even altered in some of their qualities. Second, by hybridising the indigenous seed with some of the best varieties of foreign countries which possess in the greatest degree those qualities in which the country seed is defective, but which are found difficult to cultivate in India, as for example Sea Island Cotton. If the properties of great length and flexibility of fibre could by hybridising be communicated to the indigenous cotton, a staple would be obtained of great value in the English market."

The following is an extract from a minute by Sir W. Denison:—

"I am induced to bring under the consideration of the Council questions connected with the improvement and extension of the growth of cotton in the Presidency of Madras, by the publication of a resolution of the Governor-General in Council, to the effect that prizes of 10,000 rupees will be given during the years 1861-62, 1862-63 in each of the Presidencies of Fort William, Madras, and Bombay, under certain conditions made known in the proclamation. The subject of the extension of the cultivation of cotton in the British colonies has been under my consideration for many years past. In Australia various attempts were made to introduce the finer species of American cotton, and, so far as the quantity and quality of the cotton were concerned, these attempts succeeded; but the high price of labour was a complete bar to the introduction of cotton as a paying crop. Since my arrival in Madras the same subject has been brought before me in various ways, at one time in the shape of suggestions for the improvement of the means of conveyance by water or railways, for the purpose of bringing more cheaply to market the surplus produce supposed to exist in the interior; at another, as in the present instance, by proposals to stimulate the cultivation by the offer of prizes. I have in consequence been led to make a variety of inquiries from persons engaged in the cultivation of cotton, and from others, and the following are the results to which these inquiries have led:—

"(1.) That the great surplus of cotton supposed to exist in the interior of the country, and which only awaits cheaper means of conveyance to bring it to market, is the product of the imagination of those whose object it is to show that there is traffic sufficient to defray the cost of transport, as well as the interest of money invested in railroads or canals, as the case may be. Cotton is cultivated, and that largely, in various districts; but this is generally done by the ryots under the stimulus of an advance of capital from a merchant or speculator, and on the security of a fixed price per pound for the crop. There is therefore little or no surplus beyond that already, so to say, mortgaged to the merchant, at a price low enough to enable him to pay all costs and charges to the port of shipment.

"(2.) That the extensive districts of what is emphatically called 'Cotton soil,' though well adapted to produce native cotton, which is short in the staple and strong, not to say coarse, in the fibre, is not congenial to the growth of the fine species of American cotton. This kind of cotton I know, from experiments in Australia, to flourish in a light sandy loam, and I am told that similar results have been obtained here. The 'cotton soil,' which is an adhesive black clay, almost of the consistence of birdlime, when thoroughly wet, dries into the consistence of a brick, but crumbles under the action of the sun and slight showers into a light dry powder. In the dry season this soil cracks deeply, showing, by the amount of shrinkage when the water evaporates, that it contains a very large proportion of clay. The experiments which have been made on the cultivation of the American cotton on this soil have hitherto been unsuccessful. That there are soils in which these cottons can be grown is very probable. In the red soil of Coimbatore Bourbon cotton is grown to some extent, and it is possible that other sites may be found where the Upland or New Orleans cotton may be grown with advantage.

"With a view, then, to the development of the cotton-producing powers of India generally, by which the English manufacturers might be relieved from their present dependence upon the supply from America, two courses appear to present themselves:—

"(1.) The encouragement, by every means, of the introduction of the better species of American cotton.

"(2.) The improvement of the native cotton, by increasing the length of the staple, and lessening the coarseness of the fibre. Attention paid to the last of these two schemes would be likely to yield results more profitable to the cultivator, and more advantageous to the manufacturer, than any which would result from the cultivation of American cotton. In the first place, we know that there is a large extent of soil well fitted for the cultivation of this particular species; that little encouragement will be required to induce the ryots to cultivate it upon the soil; that any rise of price contingent upon the improvement of the quality of the cotton, unaccompanied (as will be the case) with any increase in the cost of cultivation, is to the direct advantage of the ryot, and will do much to stimulate production. On the other hand, the cultivation of the American cotton must be at first an experiment; it is known to be a precarious crop, and the better the quality and the higher the price the smaller is the yield per acre.

"While, however, I am inclined to advocate the improvement of the native cotton as the most profitable crop, I am by no means disposed to check attempts to acclimatise the better descriptions, and I will now proceed to describe, first, the process by which it is probable that the native cotton can be improved, and, secondly, the steps which it would be desirable that the Government should take to encourage a series of experiments in various parts of the country, partly with a view to the introduction of new species of cotton, partly with a view to the improvement of the indigenous species. I must premise that the mode of improving the native cotton has been suggested by the Marquis of Tweeddale, who explained the process to Mr Thomas, the collector of Coimbatore, in a letter which that gentleman communicated to me.

"The process is as follows:—From the seed pods of this year's crop take out those seeds to which the largest fibres are attached, establishing a minimum length of fibre, and throwing away all those seeds the cotton of which does not reach this standard; these selected seeds will be used for the next crop, and a similar process will be followed with this, the minimum length being increased every year. In this way, in the course of a few years it is probable that a permanent addition will be made to the length and possibly to the fineness of the fibre, and it will then be easy to spread the seed of the improved kind over the whole of the indigenous cotton fields of India.

"In the resolution of the Governor-General in Council to which allusion has been made, a former resolution of 28th February is referred to, in which the following principle is laid down: 'That no measure which places Government in the position of the private capitalist, or cultivator, or which in any way interferes with private enterprise, can be otherwise than permanently injurious in itself and detrimental to the object in view. Therefore all attempts to stimulate cultivation or labour by any exertion of Government authority, directly or indirectly, are out of the question. The same objection will apply to model farms and experimental cultivation conducted by officers of Government.'

"Approving generally of the principle laid down, though perhaps I might demur to some of the deductions if carried out generally, I will now explain the mode in which I propose that the Government should act to encourage the experiments detailed above, as well as those which have for their object the introduction of the better qualities of cotton.

"The object being to improve the quality of the cotton grown on what is called the 'cotton soil,' I should propose to allow to a few intelligent natives in different parts of the country, who may be willing to undertake these experiments, a remission of all assessment upon a certain quantity of land, not exceeding say thirty acres in extent, for a period of five years, upon condition that this land should be devoted to cotton cultivation, and that an annual return should be made to the collector, showing the area under cultivation, the cost of cultivation, the amount of the crop, &c. &c., and that this should be accompanied by a sample of the crop, showing all the varieties of cotton grown.

"In addition to this a reward should be promised to all who, at the end of five years, should be able to show that the produce of their land was superior in value, taking quantity and quality into consideration, to that of similar land under cotton cultivation, and this reward should be made in some measure proportionate to the improvements in the quality of the cotton, whether this be the result of a change in the quality of the native cotton, or of the introduction of a superior species; in fact, it might almost be made proportionate to the price of the cotton sent to market; and as in the present instance the Governor-General in Council has not hesitated to offer a reward of 10,000 rupees in a single prize, I do not think that there ought to be any hesitation in establishing a gradation of prizes varying from 100 to 5000 rupees, according to some scale to be hereafter determined, the highest premium being given to the successful cultivator of cotton, whose value per pound and the value of the crop per acre should not be less than the sums determined on."

5. *Remarks on the Polar or Compass Plant.* By WM. GORRIE, Esq.

Mr Gorrie remarked that *Sylphium laciniatum* is probably the plant referred to under that name in the "Scalp Hunters," and other popular works. It belongs to the natural order *Compositæ*, sub-order *Tubuliforæ*. It is called also Rosin-weed. Its stem when fully grown is 3 to 6 feet high, leaves very rough, pinnately-parted, petioled, but dilated and clasping at the base. The lower leaves are 12 to 20 inches long, ovate in outline; on the wide open prairies they are said to present their faces uniformly north and south. The heads of the flowers are 1½ to 2 inches in diameter. The plant is found on the prairies of Michigan and Wisconsin, and thence southward and westward. Longfellow, in his "Evangeline," alludes to it thus:—

> "Patience," the priest would say, "have faith and thy prayer will be answered.
> Look at this delicate plant that lifts its head from the meadow,
> See how its leaves all point to the north, as true as the magnet.
> It is the compass flower that the finger of God has suspended
> Here on its fragile stalk, to direct the traveller's journey,
> Over the sea-like, pathless, limitless waste of desert."

Dr Alexander Dickson exhibited a series of microscopical preparations showing the centrifugal development of the ovules on the placenta of *Primula vulgaris*. Also, a portion of a poppy capsule macerated so as to show the arrangement of the vascular bundles—the strong ribs in the wall of the seed vessel corresponding to the lines of junction of contiguous carpels, and not to midribs as might have been imagined. From these ribs are given off all the smaller vessels of the wall, as well as those ramifying in the placenta to supply the ovules.

Professor Balfour presented for Professor Dickie the following specimens:—*Buxbaumia aphylla*, which had been picked in large quantity (upwards of 200 specimens) in the parish of Towie, Aberdeenshire, in July 1861, by Mr Coutts; *Anœcalypta latifolia*, from a rocky hummock above the village of Castleton, Braemar; *Orthotrichum arcticum*, from the east side of Davis' Straits, collected by Mr Taylor. Professor Dickie also reported that *Cystopteris montana* had been found in Canlochan Glen, and other places in the Braemar district.

Captain Playfair sent seeds of an undescribed species of *Poinciana*, found at Aden, and which had been named by Dr Anderson of Calcutta *P. Playfairii*. The plant is a very handsome species, with pure white flowers, changing to a pale buff colour when slightly faded.

Mr Archibald Hewan, of Old Calabar, sent specimens of *Scleria Flagellum*. He says: "This sedge, growing to the height of several feet, supporting itself by intertwining upon neighbouring shrubs, may be truly called 'Nemo me impune lacessit,' it catches so speedily upon a very slight contact with it."

Mr M'Nab gave the following report on the flowering of plants in the open air in the Botanic Garden:—*Eranthis hyemalis*, January 16, 1862; *Corylus Avellana*, January 18; *Rhododendron atrovirens*, January 26; *Garrya elliptica*, January 28; *Crocus susianus*, January 28; *Helleborus purpureus*, January 29; *Leucojum vernum*, February 1; *Galanthus plicatus*, February 1; *Crocus vernus* vars., February 2; *Hepatica triloba*, February 7.

Professor Balfour mentioned that Professor Blume, the celebrated Dutch botanist, and an honorary member of the Society, had just died at Leyden, and that Willem Henderick de Vriese, another celebrated botanist, had also died at Leyden, on 23d January last. He had also to record the death of Mr Borrer, the eminent English botanist, and a Fellow of the Society; also that of Mr John Livingston, who had contributed valuable physiological papers to the Society's proceedings.

SCIENTIFIC INTELLIGENCE.

BOTANY.

On the part played by the Mycoderms in Acetic Fermentation. By M. L. Pasteur.—Naturalists designate under the name of mycoderms those pellicles commonly called scums which make their appearance on the surface of all fermented liquors. One of them deserves especial mention, that, namely, which is sometimes found in vessels which contain vinegar, under the appearance of a membrane, more or less difficult to tear, of a gelatinous consistency, and which has been long known in the language of the manufacturers by the characteristic name of *mother of vinegar*. On this subject Berzelius expresses himself in these terms. "Vinegar," says he, "kept in vessels where it is in contact with the air, loses its transparence; a coherent gelatinous mass gradually gathers in it, which appears slippery and swelled when it is touched, and from which the liquid that it contains cannot be pressed out. This mass has received the name of *mother of vinegar*, because it was erroneously believed that it was capable of determining the acetic fermentation . . . .; in a state of purity it is destitute of this property, which is entirely owing to the acetic acid which is contained within it." Various practices of the vinegar-makers agree completely with the opinion of Berzelius.

A remarkable fact, discovered in 1823 by Edmond Davy, has exerted great influence on the theory as well as on the industrial process of making acetic acid. Platinum-black moistened with alcohol diluted with water becomes heated, and gives birth to acetic acid. This fact has become the occasion of a new process for vinegar making. Alcoholic liquids are made to flow over beech shavings piled up in barrels in which the air can circulate freely. The shavings, it is said, performs the same service with platinum-black, that of a porous body, which condenses the oxygen of the air. In a word, nothing is more obscure than this vinegar making, entirely abandoned as it is to empiricism and routine . . . . .

In the researches I have been pursuing for several years on fermentation, several indications had led me to think that the mycoderms might be concerned in the formation of acetic acid. These indications multiplying more and more, I applied all my efforts to follow them by direct experiments.

Of the different mycodermic species, that which is the most easy to cultivate, if I may be allowed the expression, is undoubtedly the scum of wine, the *Mycoderma vini* or *cerevisiæ*. It was on it I began my studies. Their first results were directly contrary to what I expected. In causing the scum of wine to form on various alcoholic liquids in contact with the air, I did not obtain any acetic acid at all. Nay, more than this, if I introduced directly into the liquid a certain proportion of this acid it gradually disappeared. It was the same with alcohol. Nevertheless these results were not constant. But what is essential to remark is, that all these facts were subordinated to the presence and life of the mycoderms. I shall return to these apparent complications. But let us consider not the scum of wine, but of vinegar, the *Mycoderma aceti*.

In cultivating this new species, pure and without mixture. on the surface of alcoholic liquids, I ascertained this time, as the general character of the phenomena, that the alcohol always became acetic with the intermediate formation of small quantities of aldehyde. As to the correlation between the manifestation of the chemical phenomena and the presence of the plant it was as rigorous as in the first case.

That being determined, let us repeat the preceding experiments relative to our two mycoderms in close vessels, where we can shut up besides the liquid and the seeds of the plant under experiment, a determinate volume of air, and in such a way that we shall be able at any time to add to the analysis of the liquid that of the atmosphere of the vessel. The understanding of the phenomena then appears in all its simplicity. In fact, it is seen that the mycoderm of the vinegar takes the oxygen of the air and fixes it upon the alcohol, and so makes acetic acid of it, and that the mycoderm of the wine takes equally the oxygen of the air, and fixes it equally upon the alcohol, but so as to make of it the vapour of water and carbonic acid. It is further seen that, if the alcohol is suppressed, and the mycoderm of the vinegar is made to grow in an acetic liquid, the acid is transformed into water and carbonic acid. With the mycoderm of wine the effect is the same, although there may have been alcohol in the liquid.

Consequently, if we remark that aldehyde is nothing else but alcohol minus hydrogen, that acetic acid is alcohol which has undergone a further combustion, and that, in short, alcohol and acetic acid, when they experience complete combustion, are transformed into water and carbonic acid, we will logically infer from what precedes that the scum of wine behaves exactly like the scum of vinegar, only that there are circumstances in which its properties are exalted,—that is to say, that the plant, instead of taking from the air two or more molecules of oxygen in order to fix them on a molecule of alcohol to make aldehyde or acetic acid of it, seizes on eight or twelve molecules of this gas, and, by their aid, transforms completely the alcohol and acetic acid into water and carbonic acid. And all these facts are accomplished with great force, with a great disengagement of heat, and a rapidity which would astonish the boldest imagination.

Thus we see how the same plant which provokes the acetification of alcohol can destroy the acetic acid which it has formed. We see also how the manufacturer who first called the mother of vinegar *the flower of vinegar*, was guided by a true instinct. We see also how Berzelius, on the other hand, in refusing to the mother of vinegar the power of producing acetic acid because it destroyed that acid, advanced a true fact, of which the interpretation alone was erroneous.

I have ascertained that the scum of vinegar no longer determines acetification when it is submerged. In order that it may act, it is necessary that it cover the surface of the liquid. In the vinegar works those deposits in the tuns, which the manufacturers call *mères*, have no sort of acetifying action. Everything takes place at the surface of the liquid.

In this way I demonstrate these facts experimentally. I determine the acetification of an alcoholic liquid by the aid of the vinegar plant, and in such a way that the frond of the plant may become so strong as to be difficult to break. At the same time, I measure day by day the progress of the acidity of the liquid. Then, at a given instant, I submerge the frond by means of heavy glass rods, which oblige it to fall to the bottom of the liquid. Immediately the acetification is arrested, and it remains so two, three, four, five, six days or more. And as soon as a new frond appears, the continued analysis of the liquid indicates that the formation of acetic acid is renewed. This result proves that the plant does not act by a principle which it could secrete in order to diffuse it in the liquid. It shows, besides, that the cause of the chemical phenomenon which accompanies the life of the plant resides in a peculiar physical state analogous to that of platinum-black. But it is essential to remark that this physical state of the plant is closely bound up with the life of that plant. The following is one of the proofs of this assertion. On the surface of an alcoholic liquid containing essentially phosphates and albuminoid substances, I make the scum of wine grow till the whole surface of the liquid is covered with it. I ascertain day by day that there is a disappearance of alcohol and of acetic acid, if any has been added to the liquid. Then with a syphon I draw off the liquid which produced the plant, without tearing the frond of the mould—a condition easy to fulfil. Then I substitute for the first liquid pure alcohol diluted with water. The mycoderm (difficultly wet, on account of its oily principles) rises and covers the surface of the new liquid. The little plant has then no more for food but the principles which it can find in itself. Now the experiment demonstrates, in these abnormal circumstances of sickness or of relative death, that the plant which, one moment before in full health, effected the combustion of alcohol and of acetic acid, transforms now alcohol into acetic acid only. This experiment proves that the sick plant does the same thing as the healthy plant, but with less energy.

I come now to the process of acetification by the beech shavings. All authors are agreed on the theoretical explanation of this mode of manufacture. The shavings, say they, act like porous bodies, after the manner of platinum-black. This opinion is altogether erroneous. I am going to show that the shavings have no action by themselves, and that they do nothing but serve as a support for the development of one of the mycoderms, particularly the *Mycoderma aceti*. In fact, let us make alcohol diluted with water to flow over shavings or along a cord, the drops which fall at the extremity of the cord do not contain the smallest quantity of acetic acid; but let us repeat this experiment after having steeped the cord in a liquid on the surface of which there is a mycodermic pellicle, which remains in part on the cord when it is withdrawn from the liquid, then the alcohol, which is then made to flow slowly along this cord in contact with the air, is charged with acetic acid.

If the mycoderms had only the property of being the agents of combustion for alcohol and acetic acid, the part which they play would on that account be worthy of fixing the attention. But I have discovered that this property has an extent of action which opens up a new field of study for physiology and organic chemistry. In fact, the mycoderms can carry the burning action of the oxygen of the air on a multitude of organic matters,—the sugars, the organic acids, various alcohols, the albuminoid substances giving rise in certain cases to intermediate substances, of which I have already discovered several.*

I will yet add, that the property now discussed is found in various degrees in moulds; and everything induces me to believe in the most minute of the infusoria. I have ascertained that one can, by the development of a mould, transform into water and carbonic acid relatively considerable quantities of sugar, without there being left in the liquid the smallest quantity of that substance.

If the microscopic beings should disappear from our globe, the surface of the earth would be encumbered with dead organic matter, and dead bodies of all sorts, animal and vegetable. It is they principally which impart to oxygen its burning properties. Without them, life would become impossible.

After death, life reappears under a new form, and with new properties. The germs of microscopic beings everywhere diffused commence their evolution, and by their aid, and by the strange power which forms the object of this memoir, oxygen is fixed in enormous quantities on the organic substances which these beings have invaded, and gradually effects their complete combustion.

---

* It appears to me necessary, in this point of view, to revise all that relates to nitrification.

Permit me, in bringing to a close this too rapid sketch, briefly to characterise the results of this work in another point of view. We have just learned that organised cells exist which have the property of carrying the oxygen of the air upon all sorts of organic substances, burning them completely, with a great disengagement of heat, or arresting them as substances of various compositions. This is the faithful image of respiration, and of the combustion which is its consequence, under the action of these organised globules, which the blood brings, without ceasing, into the cells of the lungs, where they come to seek the oxygen of the air, in order to diffuse it afterwards in every part of the body, with a view to burn there in different degrees the principles of the organism.—*Comptes Rendus, February* 10, 1862.

GEOLOGY.

Tertiary Fossil Fruits found in connection with the Lignites of Brandon, Vermont, United States. By LEO LESQUEREUX.

1. Carpolithes Brandoniana, sp. n.
2. ,, fissilis, sp. n.
3. ,, irregularis, sp. n.
4. ,, Grayana, sp. n.
5. ,, bursæformis, sp. n.
6. ,, venosus ? Sternb.
7. Carya verrucosa, sp. n.
8. ,, Vermontana, sp. n.
9. Fagus Hitchcockii, sp. n.
10. Apeibopsis (Cucumites), Heerii, sp. n.
11. ,, ,, Gaudini, sp. n.
12. Aristolochia Œningensis, Heer.
13. Aristolochia curvata, sp. n.
14. ,, obscura, sp. n.
15. Sapindus Americanus, sp. n.
16. Cinnamomum Novæ Angliæ, sp. n.
17. Illicium lignitum, sp. n.
18. Drupa rhabdosperma, sp. n.
19. Carpinus grandis ? Heer.
20. Leguminosites pisiformis ? Heer.
21. Nyssa complanata, sp. n.
22. ,, microcarpa, sp. n.
23. ,, lævigata, sp. n.

American Journal of Science and Arts, November 1861.

Labyrinthodon.—We have been informed by the Rev. W. S. Symonds of the discovery of the remains of the Labyrinthodon in the Keuper sandstone of Pendoch, Worcestershire. The bones appear to be those of the head, and are similar to the specimens in the Warwick Museum. They occur in a "bone bed," full of the spines and teeth of a Keuper fish, *Lophodus Keüperinus.*

ZOOLOGY.

Synopsis of a Course of Lectures given at the Museum of Natural History (Paris), in 1850; by M. ISIDORE GEOFFROY SAINT-HILAIRE.

1. *On the Animal Series, and the Parallelic Classification.*

(1.) The various zoological types may be reduced to a serial or progressive order.

(2.) The principle of co-ordination of the series resides essentially, not as was vaguely said before the time of Lamarck in the greater or less *perfection* or *complication* of organisation, but in its *diversification*, *specialization* and *centralization*, which are at the maximum at one extremity of the series, at the minimum at the other.

Thus, at the top, the beings whose apparatus, organs, and tissues are the most *diversified*, whose functions are the most *specialized*, whose organism is the most *centralised ;* at the bottom, the beings whose composition is the most *homogeneous*, in whom the functions are the most completely confounded, and the life, in some sort, *diffused*.

(3.) In the animal series, sometimes the terms succeed each other at very close intervals, occasionally even, without sensible interval; sometimes two consecutive series remain at a great distance from each other. The series is then neither *regular* nor *continuous*.

(4.) Neither is it *simple*. Often, and even most usually, it is double, triple, or more complex still, successions of terms manifestly analogous being found in two or several groups otherwise distinct. These successions of analogous, or as they would be better called, *homologous* terms in different groups, are what we have named *parallel series*.

(5.) Hence arise double relations which it is important to know and to express. Great attention has always been paid to the *affinities* which unite the *varied types* comprised in the *same group ;* the knowledge of the affinities which *bind together* the *homologous types* existing in *different groups*, is not less necessary to the rational conception of the series and to the expression of their natural connections.

(6.) This expression, it has seemed to us, can be given by the new system of classification, known as the *parallelic classification*, or classification by *parallel series*, which is on the whole but a very simple improvement on the system usually employed.

Suppose a group *n*, comprising several secondary types which we shall designate by the letters *A*, *B*, *C*, *D*, *E*.

Suppose another group *N*, holding the relations with the first which we have just indicated, that is to say, of which the secondary types are homologous to the preceding. We shall call them, to express at once the *continued* difference and the homology, *a*, *b*, *c*, *d*, *e*.

Suppose a third group **n**, giving similarly a, b, c, d, e. A fourth N, giving A, B, C, D, E, and so on.

It is manifest that the expression of the multiplied relations, existing between all these terms will be obtained, if on the one hand, the terms of each series, *A*, *B*, *C*, &c., *a*, *b*, *c*, &c., follow each other without the intercalation of any foreign term; and on the other, if the homologous terms of the various series, *A*, *a*, a, *B*, *b*, b, &c., are in apposition to each other. The parallelic classification satisfies these two conditions by the following combination, simple enough to be seized at a glance:

A	*a*	a	A
B	*b*	b	B
C	*c*	c	C
D	*d*	d	D
E	*e*	e	E
F	*f*	f	F*

---

* For greater simplicity we have here supposed the four series equally extended, and without gaps. In reality it is scarcely ever so. For example, there might be *A*, *B*, *D*, *E*, *F*; *a*, *c*, *d*, *f*, &c. The series are not the less manifestly parallel, only, some terms remain without homologues.

(7.) There exist, so to speak, parallelisms of all degrees. The species of one and the same genus, the genera of one and the same family, often form parallel series; it is sometimes thus (to go no higher) with the classes of the same branch. The word *type* just now employed, may then receive any given value, provided that by *group* is understood a division of the degree immediately superior.

The *parallelic classification* has been for eighteen years (in 1850) applied by various authors to the greater part of the branches of Zoology, Anthropology, Teratology, and Botany.

II. *Summary of lessons on the question of species.*

(1.) The characters of *species* are not *absolutely fixed*, as many have said, still less indefinitively varied, as others have maintained. They are fixed for each species, so long as it is perpetuated in the midst of the same circumstances. They become modified if the surrounding circumstances change.

(2.) In the latter case, the new characters of the species are, so to speak, the *resultant* of two contrary forces; the one *modifying*, is the influence of the new surrounding circumstances; the other *conservative* of the type, is the hereditary tendency to reproduce the same characters from generation to generation.

In order that the *modifying influence* should predominate, in a very marked manner, over the *conservative tendency*, it is necessary, then, that a species should pass from the circumstances in the midst of which it was living, into a new and very different totality of circumstances; that it should change, as has been said, its *surrounding world*.

(3.) Hence the very narrow limits of the variations observed amongst wild animals.

Hence also the extreme variability of domestic animals.

(4.) Amongst the former, species remain generally in the places and the conditions where they are established, or remove from them as little as possible; for their organisation is in harmony with these places and conditions, and would be in disagreement with other surrounding circumstances.

The same characters must then be transmitted from generation to generation.

Circumstances being permanent, species are so likewise.

(5.) Already, however, the permanence, the fixity is not absolute. The gradual expansion of a species on the surface of the globe is, at length, the necessary consequence of the multiplication of individuals. Other causes, of an order less general, may also bring about partial displacements. Whence, especially at the limits of the geographical distribution of the species most extended, arise notable differences of habitat and climate, which, in their turn, lead inevitably to secondary differences of regimen and even of habits. To these various kinds of differences correspond *races* characterised by modifications in colour and other exterior characteristics, in proportion and form, and sometimes even in internal organisation.

(These races have been arbitrarily considered, sometimes as *local varieties*, sometimes as distinct *species*.)

(6.) Among domestic animals, the causes of variation are much more numerous and more potent. In a long series of experiments which, though undertaken with a merely practical object, have no small theoretic importance, species of various classes, to the number of about forty, have been constrained, by the intervention of man, to quit savage life, and bend to very different habits, regimen, and climates. The effects obtained have been in proportion to the causes; there have been formed a multitude of very distinct races; amongst them several offer characters equal in value to those by which genera are commonly differentiated.

(7.) The return of many of the domestic races to the wild condition has taken place on various points of the globe: thence, a second series of experiments inverse to the preceding, and furnishing the counter-proof. If domesticated animals are replaced in the circumstances in the midst of which their wild ancestors existed, their descendants, after some generations, resume the characters of the latter. They only assume analogous characters if they are restored to savage life under conditions analogous, but not identical.

(8.) To resume: the observation of wild animals strictly demonstrates the *limited* variability of species.

The *experiments* on wild animals domesticated, and on domestic animals returned to the wild condition, demonstrate it more clearly still.

The same experiments prove, moreover, that the differences produced may be of *generic value.*

(9.) The truth or error of a doctrine may also always be brought to light by the value of the consequences derived from it.

The *theory of limited variability* may lead to *rational* solutions with respect to questions completely insoluble for the partisans of absolutely fixity, or which the latter can only resolve by aid of the most complex and improbable hypotheses.

(10.) It is thus with the fundamental question of anthropology. The common origin of the various human races is *rationally* admissible in the point of view of variability, and *in this point of view alone.* In order to admit it with us, the partisans of *fixity* have been forced to conclude against their own principle.

(11.) In palæontology, to the theory of limited variability corresponds a simple and rational hypothesis, that of *filiation*; to the doctrine of fixity, two hypotheses equally complicated and improbable, that of *successive creations* and that called *translation.*

According to the hypothesis of *filiation*, the existing animals are sprung from *analogous* animals which have lived in the previous geological epoch. We may, for example, seek the ancestors of our elephants, rhinoceroses, and crocodiles, amongst the elephants, rhinoceroses, and crocodiles of which palæontology has shown us the antediluvian existence.

This hypothesis has been rejected as irreconcilable with the *fixity* of species, because of the specific differences which exist between the ancient animals and their modern analogues. To the simple explanation of these differences by changes taking place, from one geological period to another, in surrounding circumstances, has been preferred the hypothesis of several *successive creations*, and, more recently, that of *translation.* To resume the example quoted above: these two hypotheses agree in admitting the complete extinction of the ancient species of elephants, rhinoceroses, and crocodiles; but the first replaces them by the elephants, rhinoceroses, and crocodiles of the *new creation;* the second, by the actual species, supposed to be pre-existent, with all their present characters, on some other point of the globe which had remained unknown. Of these three hypotheses, that which springs from the theory of variability is incontestibly the most simple and least conjectural. For this reason, it may already be presented as the most probable.

(12.) But it has not alone this advantage over the others.

It can be, and is even now, verified in its application to various particular cases.*

(13.) Moreover, it is confirmed by various considerations, in presence of which it seems difficult to maintain the other two hypotheses. Without insisting on that of *successive creations*, we shall confine ourselves to placing here, in opposition, in two of their consequences, the hypothesis of *filiation* and that of *translation.*

(14.) According to the first, the existing animals should be descended from animals merely *analogous;* according to the second, from animals *similar* to themselves. Now, the preservation of the *same characters at all periods,* would suppose the existence, *at all periods* also, of the *same* surrounding *circumstances,* which is *inadmissible.*

(15.) In the hypothesis of *filiation*, the number of species might vary, becoming greater or less from one geological period to another; for if, at each revolution, there has been an extinction of a portion of the species, those which remain *must* have undergone modifications, various according to circumstances, and which *may* have acquired the value and permanence of specific characters. In the opposite hypothesis, at each revolution, a portion of the species disappears; the others *remain what they were:* they are displaced, but without undergoing organic modifications. Consequently, the extinctions are here *without any possible compensation.* Then, according to this hypothesis, the number of animal and vegetable species must have gone on constantly decreasing; there would be a *progressive diminution*, a depopulation of the globe: the two hundred and sixty thousand animal and vegetable species which, according to the most recent estimations, now cover the surface of the earth, would be but the wrecks of a creation infinitely richer in past times.

Such is the consequence to which the hypotheses of absolute fixity and of translation naturally lead: each will judge how far it agrees with the notions that we possess on the ancient condition of the globe.

(16.) The substitution of the theory of *limited variability* for the hypothesis of absolute fixity renders necessary a new definition of species.

To approach as nearly as possible the definitions most in use, and, for the moment considering only the existing order of things, we shall say:—

Species is a collection or succession of individuals characterized by a combination of distinctive features, the transmission of which is NATURAL, REGULAR *and* INDEFINITE *in the existing order of things.*

The possibility of distinction, the natural and regular transmission, stability, and permanence, equal those of the present condition of the globe—such are the three essential elements of this definition of species.

---

* Which has been demonstrated in the Course of Lectures of 1847.

A few words are necessary to explain the terms of it.

Hybrids are not generally unfruitful, as has often been said;[*] they can transmit their characters, *always mixed*. Hybrid races are not propagated with the constancy and regularity observed in species; they soon die out, or return by the effect of crossing, to one of the species whence they sprung. The transmission is then neither *regular* nor *indefinite*.

It is the same with monstrous or anomalous races.

Domestic races approach much more nearly to species. Amongst those which are very ancient, and which have thus acquired a great fixity, the transmission may even be said to be *regular*: it may be *indefinite*, and as durable as the existing order of things, but only by the intervention of man, which is necessary to maintain the races as it was to create them. The transmission is not then natural.—*American Journal of Science and Art. Nov.* 1861.

MISCELLANEOUS.

Glaciers in New Zealand.—Mr Julius Haast has recently published a "Report of a Topographical and Geological Exploration of the Western Districts of the Nelson Province, New Zealand," undertaken for the Provincial government. He states that being under engagement to survey the Southern Alps of that country, a magnificent mountain chain of an altitude of 11,000 to 13,000 feet, and covered with perpetual snow, from which, in every direction, glaciers descend, he thought it his duty to reserve the name of Forbes for the first mountain from which he should find a glacier descend, intending thus to name it after one to whose labours science owes so much in the investigation of those beautiful phenomena. Ascending the Rangitata, and following the southern source branch, he had the pleasure of seeing before him a most magnificent mountain chain, the rugged snow-covered peaks of which projected high in the deep-blue sky of New Zealand. The sides were everywhere covered with glaciers, from the icy caverns of which rushed turbid streams which, uniting, soon became a considerable river. He called the mountain chain the Forbes Range, the principal glacier the Forbes Glacier, and the stream the Forbes, in testimony of his gratitude for the manifold instruction which he had obtained from Principal Forbes' works. His friend and companion, Dr A. Sinclair, who was drowned a few weeks afterwards in the Rangitata, was with him when he named the mountain, and assisted him in his researches, having taken the botanical department. The investigation of the Southern Alps is a most pleasing task, presenting numberless points of the highest geological interest, of which Mr Haast will treat fully in a report which he purposes writing next year.

The Livingstone Expedition.—Letter from Bishop Mackenzie.—Mohella is the smallest of the four islands which are called the Comoro Islands. Its extreme length is fourteen miles and breadth eight. The highest point seems to be 3000 feet. It is covered with verdure, which is always fresh; and plenty of tropical trees, coco-nuts, baobab, and others, occupy the steep sides of its valleys, and cover even the tops of the ridges. It is governed by a queen, whom we saw yesterday. We rowed in one of the ship's boats four or five miles, and came in sight of the town after rounding a projecting low point. Our eyes were at once arrested by a wall about twenty feet high, pierced for guns (forty in number), which we found, on closer inspection, to be mere rubblework—the stones not much larger than one's head, built with lime and mortar—and, as our companions told us, far more efficient than any Portuguese fort they had seen on the mainland. We were guided through a strong gateway in one of the side walls into a court, where there were two small cannon—I suppose pieces of horse artillery. At the further end was the door of the hall of public business, which we entered, and passed up between two rows of men who were sitting on the side benches. The hall may have been ten feet or twelve feet wide, and four or five times as long, lighted by high windows on one side, opening into the court. Our guide introduced us to a sallow-faced elderly man, dressed in a long white shirt, with a fine white scarf round his shoulders, and a turban. This turned out to be the second minister of state. Soon a younger, stouter, more cheerful-looking man entered; the whole assembly rose; he seated himself next the minister; we four—Livingstone, Rowley, Kirk, and myself—sitting at the head of the opposite side. This man turned out to be in no way connected with the state, but only a merchant from the neighbouring island of Johanna—a man, however, of considerable influence and esteem in that island. He acted as interpreter, and asked us what we wished. We named our wants, on which the second minister at once acceded, named the price, and referred us to a special officer (? the Minister for Foreign Affairs), whose duty is to interpret for strangers, and see that they get what they want. They asked who we were, had heard of Nyassa, could not remember the name Killimane, and finally asked if we should like to see the Queen. We went up a flight of wooden steps, partly hidden, at the upper end of the hall, and entered by a trap-door to the equal-sized room above; at the farther end was a Turkey carpet, with eight arm-chairs on both sides, facing each other, and the Queen seated at the top, and looking down the room. We made our bows and sat down. She was enfolded in broad scarfs (say half-yard wide) of rich cloth of silk and gold thread, and had on her face a Mohammedan ornament hiding her visage from the middle of the nose to the middle of the chin; she had bright black eyes, and the elder of her two sons, a boy about four years old, sat in his nurse's lap beside her. She seemed to take some interest in our affairs; asked if Rowley and I were brothers (it is not the first time it has been asked); was surprised at Dr Livingstone having spent so many years alone in Africa; asked if he had not been afraid, on which he turned to one of his Makololo, who were at the audience and returned to the Queen his answer, that if a man comes to their country quietly he need not be afraid; but if he comes to hurt them, or steal their things, they will soon frighten him. We had sherbet served in common English tumblers, and sugar-water, scented with rose-water apparently. Dr Livingstone had brought some velveteen and a piece of shawl pattern as a present, but gave it to the prince rather than to so fine a lady. On leaving, we were invited by our Johanna friend to his house, and immediately after up came two Frenchmen, a priest and a layman, of whom we had heard.

---

[*] We have given proofs of this that cannot be refuted, by uniting in two tables the indications relative to hybrid Mammifers and Birds, and *to their products.*

We promised to visit their cottage when we left our earlier inviter. He told us when we were quietly in his house, that the Mohella people were afraid of these Frenchmen, and would be glad to be rid of them, that they would like to have an English consul like Johanna, but that the ministers of State would speak to us about it. The first minister was not well, and while they went to arrange for our seeing him, we paid our visit to the Frenchmen. They did not seem to be doing much. The farmer had not begun to cultivate, nor the priest to preach or try to convert. They had been here three months, and had come from Madagascar. On leaving them we were led to the house of the first minister, a stouter, more genial-looking man than the second, though there was an earnestness and look of truth and strength of character about both.—*The Guardian.*

PUBLICATIONS RECEIVED.

1. Proceedings of the Literary and Philosophical Society of Manchester. January and February 1862.—*From the Society.*

2. Vis Inertiæ Victa; or, Fallacies Affecting Science. By James Reddie.—*From the Author.*

3. Journal of the Chemical Society for January 1862. *From the Society.*

4. American Journal of Science and Arts, for November 1861.—*From the Editors,* with the following notice:—

To the Patrons of the "American Journal of Science," and the Friends of Science in the United States.

Cut off by the exigencies of the times from a large number of our subscribers—residents in disloyal States—and participating in the inconveniences consequent on the general derangement of public affairs, the Proprietors of this Journal trust they may be permitted to express to their subscribers and to the friends of Science generally, the hope that they will in all cases renew and continue their subscriptions to the American Journal of Science for the ensuing year.

Claiming the privilege of bearing cheerfully our share of the present demands on all patriotic citizens, our hope is to receive such a measure of co-operation from the friends of Science as will enable us to sustain with credit the public trust so long, by their indulgence, committed to our hands. This co-operation we look for not only from those whose names have long been on our lists; but from many others also who may desire thus to testify their good will to the cause we represent.

Silliman & Dana,
Proprietors of the Am. Jour. Sci.

New Haven, Ct., November 1st, 1861.

Abstract of the Meteorological Register for 1861, *kept at Arbroath, by* Alexander Brown, *Honorary Member of the Literary and Philosophical Society, St Andrews; Observing Member of the Scottish Meteorological Society, &c.*

Latitude 56° 34′ N. Longitude 2° 35′ W. Distance from the Sea, ⅝ths of a Mile.
Height of the Barometer above the Sea, 75 feet; height of the Thermometer from the ground, 11 feet, and of the Rain-Gauge, 2 feet.
The number of "Rainy Days" includes those on which snow or hail fell.

1861.	BAROMETER.		THERMOMETER.							Days Ther. below 32°.	Rain in Inches.	HYGROMETER.		Fair Days.	Rainy Days.	WINDS, AT 8½ A.M.									
	Corrected to 32°, and reduced to sea-level.		8½ A.M.	7¾ P.M.	Mean.	Mean Max.	Mean Min.	Mean.	Spring Water.			Mean Dew Point.*	Degree of Humidity (complete Sat. 1·000).			N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	Total.
	8½h. A.M.	8½h. P.M.	°	°	°	°	°	°	°			°													
January, .	29·96	29 97	36·1	36 7	36·4	41·0	33·2	37·1	48·0	11	1·754	32·3	0·877	21	10	3	—	2	5	5	—	6	8	2	31
February, .	29 62	29·63	38 5	38·7	38·6	44·4	35·7	40·0	47·2	8	1·724	34·7	·878	16	12	3	—	2	3	4	5	4	4	3	28
March, .	29·45	29·45	40·7	40·5	40·6	48·3	36·6	42·4	45·7	2	1·934	35·8	·841	14	17	1	—	1	3	4	2	5	14	1	31
April, . .	30·12	30·10	45 5	45·7	45·6	52·7	39·4	46·0	46·0	2	1·349	37·5	·756	22	8	3	—	4	4	1	1	4	8	5	30
May, . . .	29 92	29·92	50·8	50·8	50·8	57·8	42·3	50·0	46·3	3	1·247	41·0	·708	22	9	4	1	3	—	1	3	7	6	6	31
June, . .	29·92	29·90	56·8	57·5	57·1	62 8	50·8	56·8	47·5	—	2·528	50·0	·819	21	9	3	4	3	6	4	1	1	2	6	30
July, . .	29·59	29·58	58·8	60 0	59·4	66·2	51·1	58·7	47·7	—	2·561	52·0	·795	17	14	1	2	—	9	7	4	3	3	2	31
August, .	29·73	29 72	59·0	58·7	58·9	66·1	52·8	59·4	48·3	—	4·737	53·0	·819	15	16	—	—	1	1	7	5	12	3	2	31
September,	29·66	29 68	51·8	54·0	54·4	61·7	50 0	55·8	49 0	—	4·228	49·9	·843	11	19	2	—	3	3	4	1	5	4	8	30
October, .	29·82	29·85	49·2	52·8	51·0	55·3	45·6	50·5	49·0	—	1·979	45·1	·868	21	10	3	—	1	4	6	3	4	5	5	31
November,	29·45	29·45	38·2	38·6	38·4	43·6	34·1	38·8	48·0	12	3·511	33·0	·841	17	13	5	1	1	2	2	4	4	9	2	30
December, .	29·97	30·03	36 0	36·8	36·4	41 6	33·9	37·7	47 5	12	2·104	33·5	·923	21	10	3	—	—	2	—	2	9	8	7	31
Mean, . .	29·77	29·77	47·1	47·5	47·3	53·4	42·1	47·7	47 5	50	29·656	41·5	0·831	218	147	31	8	21	42	45	31	64	74	49	365
Do. 1860, .	29 72	29·72	44·3	44·1	44·2	50 8	39·2	45·0	47·8	104	30·475	38·7	0·823	216	150	29	12	51	37	18	27	55	92	45	366

Barometer at 8½ A.M. was highest on 27th December, 30 50.† Wind N.W.
Do. do. was lowest on 19th March, 28·77. Wind N.W.
Do. at 8½ P.M. was highest on 27th December, 30·50. Wind N.W.
Do. do. was lowest on 17th March, 28 62. Wind S.
Thermometer at 8½ A.M. was highest on 20th June and 4th August, 64°·5. Wind S. and S.W.
Do. do. was lowest on 4th January, 20°·5. Wind N.
Do. at 7¾ P.M. was highest on 14th June, 67°. Wind calm.
Do. do. was lowest on 4th January, 21°. Wind N.
Thermometer in night, highest, 11th and 27th August, 57°·5; lowest, 5th January, 19°.
Thermometer in day, highest, 28th June, 19th July, 10th and 27th August, 72°; lowest, 4th January, 27°.
Coldest day, 4th January, when average of Thermometer was 23°·7 for day and night.
Hottest day, 27th August, when average of Thermometer was 64° 7 for day and night.
Coldest month of the year, January; hottest, August.
Wettest month of the year, August; driest, May.
Mean temperature of the year, 47·5 degrees.
Mean temperature of eighteen years, 45·731 degrees.

For twelve years the average daily temperature at 8½ A.M., at 7¾ P.M., and the mean of the daily extremes, are as follows, viz.:—

	8½ A.M.	7¾ P.M.	Mean of Extremes.
1850	45°·5	44°·9	45°·5
1851	45 ·7	45 ·4	46 ·3
1852	46 ·0	45 ·9	46 ·2
1853	45 ·4	44 ·9	45 ·6
1854	46 ·3	46 ·4	46 ·3
1855	44 ·2	43 ·9	44 ·3
1856	44 ·9	44 ·5	45 ·0
1857	48 ·2	47 9	48 ·1
1858	46 ·3	46 ·3	46 ·4
1859	46 ·0	45 ·4	45 ·8
1860	44 ·3	44 ·1	45 ·0
1861	47 ·1	47 ·5	47 ·7

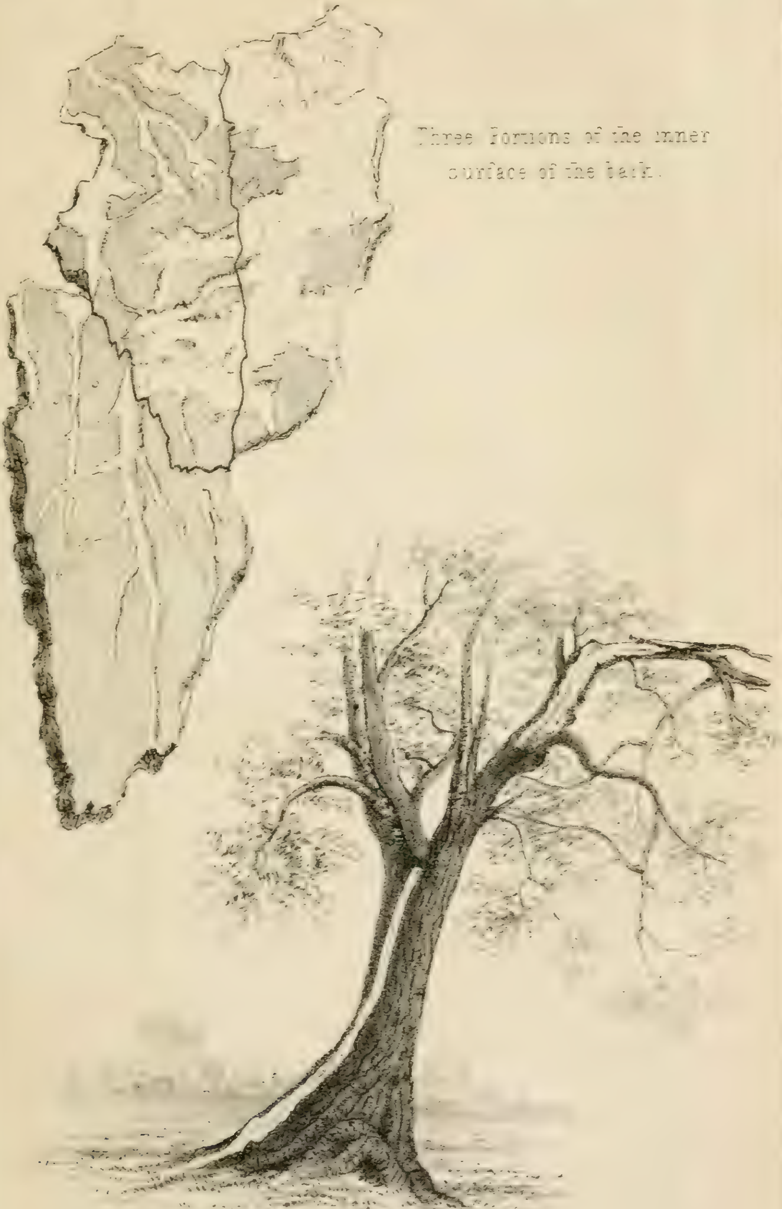
The average temperature of the six months of chief vegetation, viz., those from April to September inclusive—for twelve years, is as follows:—

1850 ... 51°·7	1852 ... 53°·0	1854 ... 53°·5	1856 ... 50°·9	1858 ... 53°·5	1860 ... 52°·3
1851 ... 52 ·0	1853 ... 53 ·4	1855 ... 52 ·1	1857 ... 54 ·7	1859 ... 52 ·9	1861 ... 55 ·2

---

* The dew-point thus found is obtained from observations of the Wet and Dry Bulb Thermometers, and deduced by Mr Glaisher's Hygrometrical Tables. The observations of the Wet and Dry Bulb Thermometers are made daily at 8½ A.M. The times of observation of the instruments stated in the Tables are Greenwich mean times.

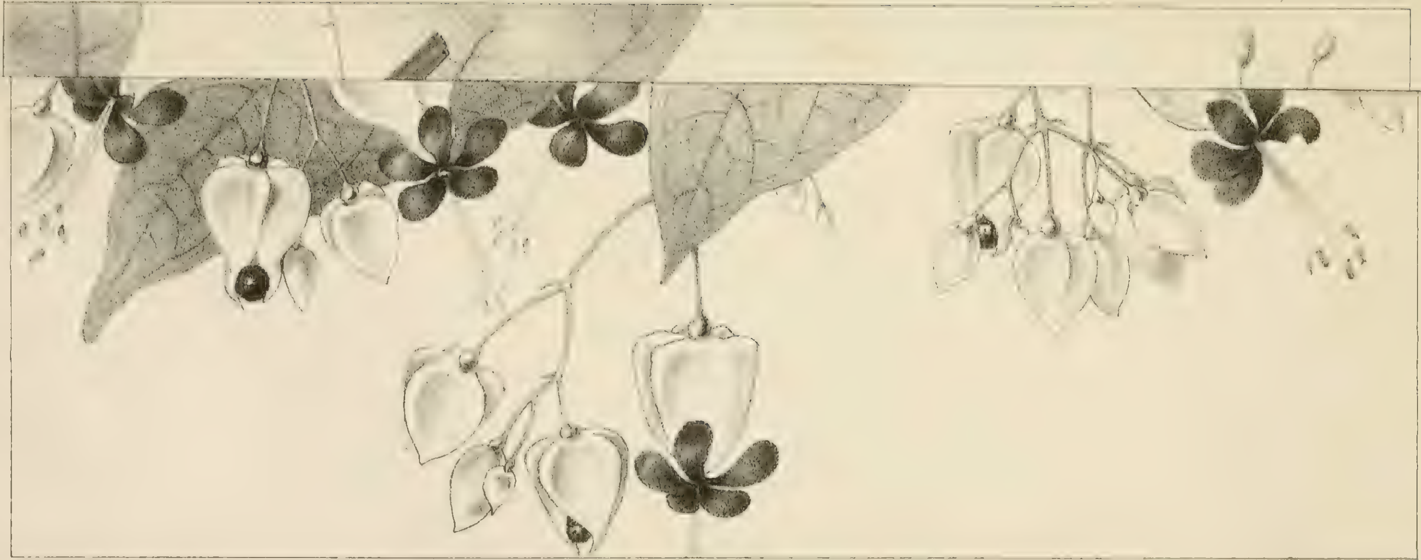
† The highest and lowest readings of the Barometer are reduced to sea-level, and otherwise corrected.



Three Portions of the inner surface of the bark.

Ash-Tree struck by Lightning, shewing the track of the discharge

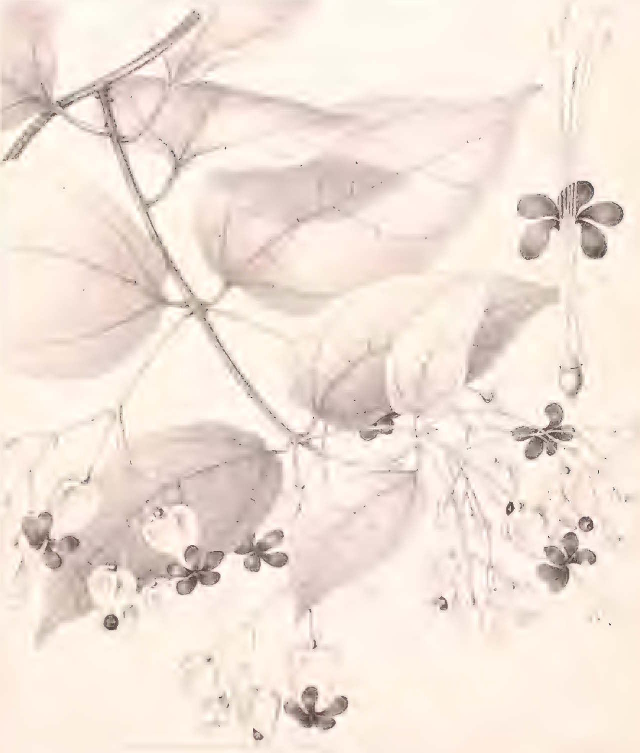
W. H. M'Farlane Lithr Edinr

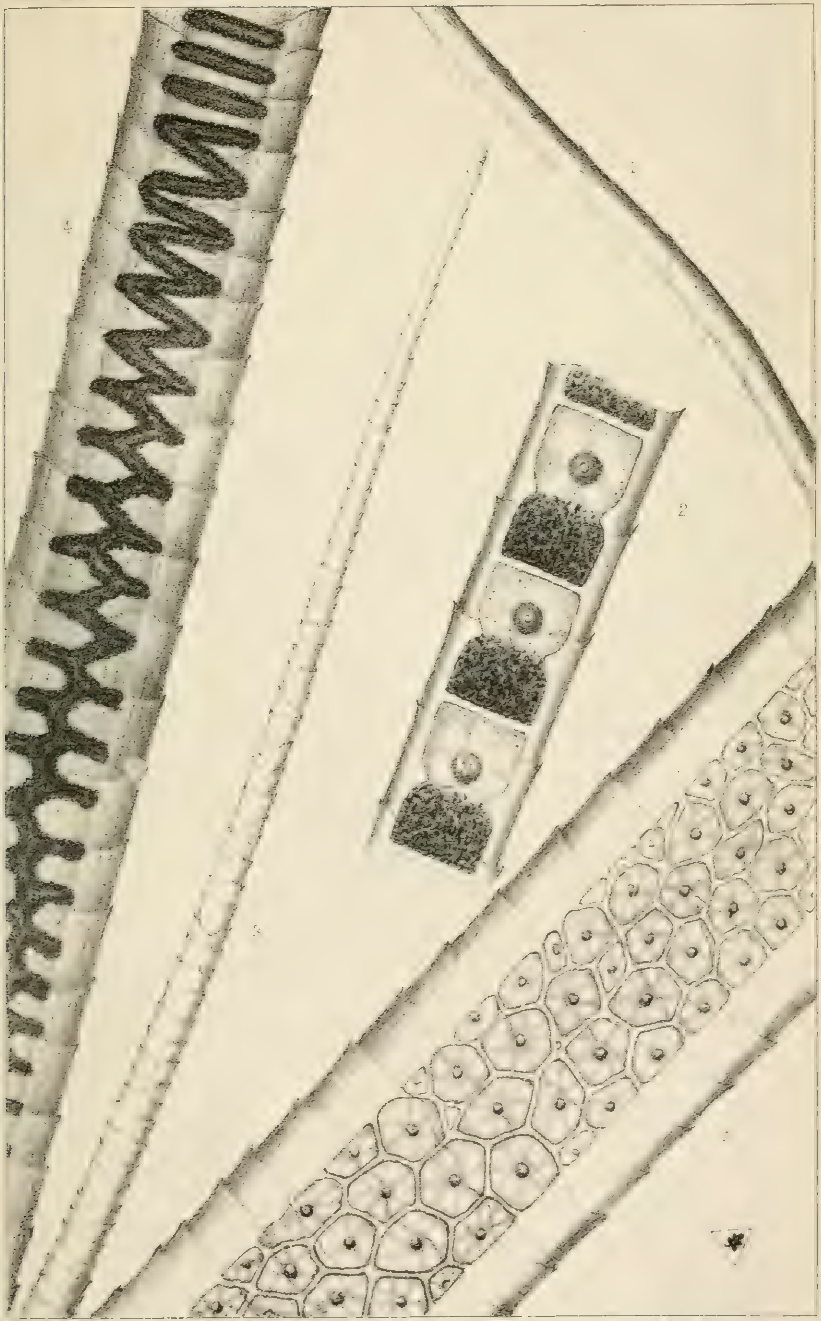


W. H. McFarlane, Lithr Edinr

CLERODENDRON THOMSONÆ BALFOUR.

[illegible]





Hair of Angwantibo

INDEX.

Aberdeen, Lord, Biographical Sketch of, 88

Æquoria vitrina, Reproduction in, by Dr T. S. Wright, 144

Aira caryophyllea in United States, 163

Allman, Professor, on the Phosphorescence of Beröe, 284

——— on the Structure and Development of the Beroidæ, 285

Anemia, Homologies of Sporiferous Appendages of, by John Scott, 314

Angwántibo of Old Calabar, 257

Animal Series, and Parallelic Classification, 328

Araücaria imbricata, Remarks on, by Mr M'Nab, 312

Atractylis arenosa, 144

Australian Expedition to Gulf of Carpentaria, 319

Balfour, Professor, Notes of Trip to North of Italy and Chamouni, 133

——— on a New Species of Clerodendron (*C. Thomsonæ*) from Old Calabar, 232

Baxter, H. F., on Nerve Force, 7

——— on the Influence of Magnetism over Organic Force, 180

——— on the Connection between Organic Force and Crystalline Force, 194

Beaver, Habits of the, 299

Beeches, Disease of, 307

Beröe, Phosphorescence of, 284

Beroidæ, Structure and Development of the, 285

Birds of Linlithgowshire and Berwickshire, by the Rev. John Duns, 295

Botanical Intelligence, 160, 324

Botanical Society of Edinburgh, Proceedings of, 130, 307

Bryson, Alexander, on the Aqueous Origin of Granite, 52

Buxbaumia aphylla, 324

Calluna vulgaris in United States, 162

Campbell, Lord, Biographical Sketch of, 95

Carrington, Dr Benjamin, on Cyperaceæ, 137

Catadioptric Altitude and Azimuth Circle, by Edward Sang, Esq., 292

Chondracanthus Lophii, Structure of, by William Turner, M.B., and H. S. Wilson, M.D., 290

Cleghorn, Dr Hugh, Notice of Voyage to Alexandria, 130

Clerodendron Thomsonæ of Old Calabar described, 232

Climate of Palestine, 169
Climatology, Medical, by Dr R. E. Scoresby-Jackson, noticed, 118
Coal, 145
Cœlenterata, Manual of, by Professor Joseph R. Greene, noticed, 129
Coffee-tree in Ceylon, Insects injurious to the, 17
Colour, Production of, by the Prism, and certain Optical Phenomena, 187
Cotton, On the Cultivation of, in India, 320
Cyperaceæ, Notes on the, 137
Dalzel, Professor Andrew, Biographical Sketch of, 282
Davies, J. Alexander, on the Production of Colour by the Prism, and certain Optical Phenomena, 187
De Candolle, Alphonse, Prodromus Systematis Naturalis Regni Vegetabilis, Part xv., 2d Section, 1st fascicula, noticed, 280
——— Casimir, on the Structure and Production of Cork in the Cork Oak, noticed, 281
Doherty, Dr Hugh, on Organic Method in Zoology, 63
Dyas, as applied to the Permian Group of Rocks, 71
Fishes, Cervical and Occipital Vertebræ of Osseous, 243
——— from Old Calabar, by Dr John Cleland, 303
Flowering of Plants in the Botanic Garden, 324
Forbes. Principal, on the Climate of Palestine in Modern compared to Ancient Times, 169
Fossil Plants in Coal-beds of Arkansas, 151
——— Fruits, Tertiary, in United States, 328
Geological Intelligence, 145, 328
Glaciers in New Zealand, 338
Granite, Aqueous Origin of, 52
Haast, Julius, on Glaciers and Alps of New Zealand, 338
Hebrides, Outer, Pagan Monuments of the, 235
Heteropoda, Anatomy and Classification of the, 289
Holothuria, New Form of, by Dr John Anderson, 302
Hydractinia areolata, 144
Ichthyosaurus Normanniæ, 160
Jardine, Sir William, on the Salmon Fisheries of England and Wales in 1861, &c., 203
King, Professor William, on certain Species of Permian Shells said to occur in Carboniferous Rocks, 251
——— on the Origin of Species, 253
Labyrinthodon, 328
Lighthouses, Commissioners' Report on, reviewed, 113
Lightning Figures, Remarks on, 46
Livingstone Expedition, 338
Macdonald, John Denis, R.N., on the Anatomy and Classification of Heteropoda, 289
Magnetism and Organic Force, 180
Malvern Hills, Chemical Geology of, 1
Medlicott, H. B., on Sub-Himalayan Rocks, 154
Meteorological Register, by Alexander Brown, 336

Molecular Arrangement in Crystals, by Professor Tait, 298

More, Professor John Schank, Biographical Sketch of, 103

Mosses, some New and Rare British, by Mr John Sadler, 309

Mueller, Dr Ferdinand, on the Umbelliferæ of Australia and Tasmania, 160

Murchison, Sir Roderick I., on the Inapplicability of the term Dyas to Permian Rocks, 71

Mycoderms in Acetic Fermentation, 324

Nardoo Plant of Australia, 319

Nature and the Bible; or, God's Two Books, by Dr T. A. G. Balfour, noticed, 127

Neitner, J., on the Natural History of the Enemies of the Coffee-tree in Ceylon, 17

Nerve Force, Remarks on, 7

Organic Force and Crystalline Force, 194

Ornithological Notes, by Dr J. A. Smith, 305

Palestine, Climate of, 169

Pasteur on the part played by Mycoderms in Acetic Fermentation, 324

Permian Shells in Carboniferous Rocks, 251

Poinciana Playfairii (T. Anderson), 324

Polar or Compass Plant of Canada, 313, 323

Ramsay, Very Rev. Dean, Address at the Opening of the Session of the Royal Society of Edinburgh, 1861, 79

Rattlesnake, Remarks on the Venom of the, by Dr S. Weir Mitchell, 163

Reviews and Notices of Books, 113, 278

Robertson, Charles, on the Cervical and Occipital Vertebræ of Osseous Fishes, 243

——— Professor James, Biographical Sketch of, 109

Royal Society of Edinburgh, Proceedings of, 130, 282

——— Physical Society, Proceedings of, 140, 299

Saccharine Urine, Remarks on the Influence of an Acid in producing, by Dr F. W. Pavy, 166

St Hilaire, Isidore Geoffroy, on the Animal Series, and the Parallelic Classification, 328

Salmon Fisheries in England and Wales in 1861, 203

Salmon-fishing in the Severn, 209

——— in the Wye, 220

Scientific Intelligence, 145, 324

Scripture and Science not at Variance, by John H. Pratt, noticed, 126

Seaforthia elegans, Bursting of Spathe of, 308

Smith, Dr John Alexander, on the Angwántibo of Old Calabar, Africa, 257

Species, Summary of Lessons on the question of, 330

——— on the Origin of, 253

Stomach, Remarks on Structure and Function of, in Vertebrata, by Dr W. Brinton, 166

Sub-Himalayan Rocks, 154

Thomas, Capt. F. W. L., on the Geological Age of the Pagan Monuments of the Outer Hebrides, 235

Timins, Rev. J. H., on the Chemical Geology of the Malvern Hills, 1

Tomlinson, Charles, Remarks on Lightning Figures, 46

Trees at Dryburgh—Measurement of, 132

Umbelliferæ of Australia and Tasmania, 160

Vaudois Alps, Flora of, by Rostan, 134

Vegetation, Rev. Hugh Macmillan's Remarks on the First Forms of, noticed, 123

Vis Inertiæ Victa; or, Fallacies affecting Science, by James Reddie, noticed, 278

Wood, Formation of, 162

Wright, Dr T. Strethill, Address to the Royal Physical Society, 146

Zoological Intelligence, 328

Zoology, Organic Method in, 63

Zoophytes, British, Observations on, by Joshua Alder, 144

END OF VOLUME FIFTEEN—NEW SERIES.

EDINBURGH: PRINTED BY NEILL AND COMPANY.

BINDING SECT.
JUN 9 1971

Q
1
E37
n.s.
v.15

The Edinburgh new philosophical journal

Physical &
Applied Sci.
Serials

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

STORAGE